Herbert Lund

October 1930

Contusion

Shock
Rest - sling
Elevation
Cold → Heat
Treat Hematoma

Blister

Aspirate
Firm Bandage Powder?

Infected

Remove epidermis
Antiseptic (mild)
Vaseline gauze

Sprain

Rest - Strapping
Heat - Massage
Joint aspirations
Gauze & Strap effusion
Gauze & Strap tendon

Strain

If pain :

Bed
Elevate
Heat

Pain goes

Walk
Snug bandage
Massage

Dislocation

Shock
Anesthesia
Reduce
Strap

Fracture

Shock
Anesthesia
Reduce
Splint

Shock

Mild

[redacted]
Head low
A m Sp. Am

Severe

Heat Comfort
Protection
Elevate Bandage extremities
Coff Sod Benz

From
Wm Mac Falls

MINOR SURGERY

By

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WITH A FOREWORD
by
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"C'est par l'étude de La Petite Chirurgie que
le chirurgien commence son apprentissage."

—*Maisonnet.*

TO

IRVING S. CUTTER

Dean of Northwestern University Medical School

THIS VOLUME IS DEDICATED WITH GRATEFUL
APPRECIATION OF HIS ENCOURAGEMENT AND
ASSISTANCE

FOREWORD

The developments of the science of medicine in the last few years have materially changed the diagnosis and treatment of disease. They have entailed, moreover, a more intensive instruction of the student in chemistry, physiology, and the basic sciences; a more elaborate study of the various major diseases and the more complicated methods of treatment, so that the medical curriculum is crowded with important major courses. Because of these changes little time has been given to the less serious ailments and injuries that form a large part of the younger doctor's practice. In common with the intern and those detached for some years from active surgical contacts, he will feel the need of a guide which the larger text-books dealing with major surgery do not provide.

The necessity for such a text-book aid is further emphasized by the great increase of accidents associated with industrial development or due to motor traffic which come under the care of the practitioner nearest the scene of the accident, regardless of his surgical experience. Persons thus injured must be given immediate and well-advised treatment, since the subsequent course of the injury is in a large measure determined by the emergency treatment rendered. Too often minor surgery becomes major surgery through carelessness or incompetence.

The dividing line between major and minor surgery is often difficult to determine, and in a desire to encompass the field the text-book designed to present minor surgery in a compact form frequently defeats its purpose by being too inclusive, and ends by doing nothing thoroughly. Dr. Christopher has avoided this error, and has presented in an adequate form the details of the diagnosis and treatment of truly minor surgery. His book is no mere compilation from previous texts; its source is his wide experience not only in this field but in general surgery, and from this experience he has chosen wisely and emphasized well.

In presenting a volume designed to meet the needs not only of the practitioners but also of the intern in the hospital Dr. Christopher has made somewhat of a departure, but one which is well advised and which fills a long-felt want. The help an intern will derive from the extensive chapter devoted to his special problems makes perusal of the volume well worthwhile.

There is no greater field for good surgery than is presented by minor surgery, and Dr. Christopher has done the profession a real service in emphasizing the importance of competent care of this group of patients.

ALLEN B. KANAVEL.

PREFACE

Minor Surgery is the surgery which has a low mortality; which requires but few assistants; which generally is done in the hospital outpatient department or in the office. It includes the large majority of surgical cases; the every-day surgical conditions. All minor surgery potentially is major surgery; often a distinction cannot be made.

For the solution of many of the problems of minor surgery considerable knowledge, judgment, and skill will be needed. There cannot be too much instruction in minor surgery. Major surgery is rarely attempted by anyone without certain minimum qualifications, but everyone, regardless of special training, practices minor surgery. The practice of minor surgery requires a broad general knowledge of surgical diagnosis, the ability to differentiate the major surgical conditions from the minor ones.

In the present volume the author has attempted to set forth such methods and procedures which have been useful in his hands. But, more important, he has attempted to give such methods of other men as have proved valuable or suggestive. Some of the material will soon require revision to conform with the progress of surgical knowledge. The author hopes he will have the opportunity to make such a revision.

The author gratefully acknowledges the help of many. In particular he thanks his artist, Myra Warner Rankin ("Miss Warner"), for her skill, patience, and industry in preparation of drawings. Thanks are also given to Dr. Allen B. Kanavel, Professor of Surgery at Northwestern University Medical School, for the contribution of a Foreword to this volume, and for his hearty encouragement and assistance; to Dr. Roscoe C. Webb, Chief Surgeon of the Great Northern Railway, for reading the manuscript and making many helpful criticisms and suggestions; to Dr. Edward A. Oliver, Associate Professor of Dermatology, Rush Medical College, for help in the sections dealing with skin lesions; to Dr. William C. Danforth, Chief of the Department of Gynecology at the Evanston Hospital for assistance in the preparation of the chapter on the Female Genito-urinary Organs; to Miss Margaret I. Maloney, Medical Stenographer, for her skilful stenography and hard work; and last, but not least, to my wife for checking the manuscript for errors in English grammar.

FREDERICK CHRISTOPHER.

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MINOR SURGERY

CHAPTER I

CLOSED WOUNDS

Definition of Wounds.—A wound is an injury or a forcible solution of continuity of any tissue of the body caused by external violence. Closed wounds are wounds without a break in the skin or mucous membrane. By violence, although physical force is generally indicated, thermo- or chemical disturbance is included. A relatively small portion of wounds belong to the domain of minor surgery.

Classification of Closed Wounds:

1. Contusions:
    - (*a*) Contusions of soft parts.
    - (*b*) Blisters.
    - (*c*) Hematomata.
    - (*d*) Contusions of bone and cartilage.
2. Sprains (wrenches of joints).
3. Strains (overstretching of muscles and tendons, including rupture of muscles and tendons).
4. Dislocations.
5. Simple fractures.
6. Lacerations of internal organs:
    - (*a*) Blood-vessels.
    - (*b*) Nerves.
    - (*c*) Gastro-intestinal tract.
    - (*d*) Lungs.
    - (*e*) Liver.
    - (*f*) Spleen.
    - (*g*) Kidneys.
    - (*h*) Bladder, urethra.
    - (*i*) Brain.

I. CONTUSIONS (BRUISES)

A contusion is a traumatic solution of continuity of tissue without causing a complete anatomical separation (Crile). It is accompanied by an effusion of blood or lymph, swelling, and occasionally by the formation of blebs. They most commonly affect the overlying soft parts of the body, the periosteum, and the cartilage. Occasionally the brain itself sustains a contusion. All contusions must be considered potentially as more serious injuries to the underlying parts until the latter be excluded.

Causes of contusions are blows, crushes, and friction, the latter being the chief cause of blisters.

Symptoms.—The symptoms of contusions are pain, swelling, and hemorrhage. The pain varies considerably with the individual and with the location of the contusion. It is brought about by the local nerve traumatism, and by the pressure occasioned by the effusion of blood and lymph. The duration is generally about twenty-four hours, and that varies, of course, according to the extent of the contusion. Certain sites of the body are particularly painful, the finger tips, the testicle, the knee margins, nerves, and cartilage being the most sensitive. The back has an extremely low susceptibility to pain from contusions.

Swelling is a constant symptom of contusion and is caused by the interference with the circulation, brought about by the effusion of blood or lymph. The swelling may be very marked and varies with the site of the body affected. It is of interest to note that swelling of the scalp may simulate a depressed fracture because of its crater-like formation.

Contusions are accompanied by hemorrhage of varying degree. *Hemorrhage* should be distinguished from congestion, in that the former means the extravasation of blood from its normal vessels, and the latter means simply accumulation of a greater amount of blood than normal in the vessels. Certain individuals are more susceptible to hemorrhage than others. In hemophiliacs subcutaneous hemorrhage may be very widespread and very difficult to control. Women are particularly susceptible to subcutaneous hemorrhage and ecchymosis will result from a traumatism that will not bring about the same result in men. By *petechiæ* is meant minute hemorrhages in the skin itself. By *ecchymosis* is meant hemorrhage in and under the skin, the familiar "black and blue marks." The effused blood causing the ecchymosis often settles to a dependent part, as to the arm in shoulder contusions; the thigh in buttock contusions. By *extravasation of blood* is meant a large quantity of blood which has spread between tissue planes. By *hematoma* is meant a circumscribed collection of blood in any tissue. Where there is little resistance offered to the blood flow, as in the scrotum, retroperitoneal tissues, etc., the bleeding tends to be progressive.

The course of a contusion in the large majority of cases is resolution and absorption. Occasionally, however, the contusion may act as a *locus minoris resistentiæ*, and an infection may be set up in this situation due to organisms from the distal portal of infection. The term *metastatic abscess* is applied to this phenomenon. The following are cases in point:

Case 1.—The patient, A. H., sustained a subluxation of the sternoclavicular articulation in a football game. At the same time he suffered from a furuncle of the elbow on the affected side. Shortly after the game his temperature rose and he began to have malaise and to feel pain at the sternoclavicular articulation. His physician treated him for several days with hot fomentations until the situation became so alarming that the surgeon was called. At this time there was a very large, brawny swelling involving the upper chest and neck; temperature 102° F.; there was dysphagia and dyspnea. Extensive incisions in the neck revealed a large abscess behind the sternocleidomastoid muscle which burrowed toward the mediastinum and up along the carotid sheath. Recovery followed drainage.

Case 2.—A boy, twelve years of age, fell off his bicycle and strained some of the fibers of the pectoralis minor muscle. There was but slight pain and the boy went on playing. At the time of the fall, however, he had an infected wound of the hand. Two days later there was marked swelling of the entire shoulder, temperature of 103° F., and inability to move the arm. After several days of hot fomentations to bring about localization, a subpectoral abscess was incised and drained through the pectoralis muscle and pus containing hemolytic streptococcus was evacuated.

Hematomata may become infected in the same manner. Contusions of the muscle may be followed by calcium deposits which give the appearance of bone in the *x*-ray and to which the term *myositis ossificans* is applied.

Contusions may be of such severity as to cause sufficient interference with the circulation to bring about an ischemic muscle contraction. Such a case is reported by Eichhoff.[1] An infant of two years sustained a contusion of the forearm without fracture. When the swelling subsided, three weeks later, the hand and fingers gradually assumed the position of flexion.

Gregora[2] reports 4 cases of gangrene of the extremities from a trauma injuring the main blood-vessel. In 3 cases the popliteal artery and in 1 case the femoral artery was injured. In 3 cases the artery was torn transversely and in 2 of these this injury occurred as a complication of subcutaneous fracture. In one of the latter the vessel was torn by a fragment of the broken bone, and in the other, by stretching or compression. Vascular injuries are most common in the lower extremities because of the proximity of the blood-vessels to the bones and their fixation in the fascia and the aponeuroses, such as Poupart's ligament, the fascia of the adductor canal, the soleus tendon, and the ligamentum interosseum. They most commonly occur at the sites of the bifurcations of the vessels. The most common causes of vascular injuries are fractures. With the exception of fractures of the forearm, all fractures may lead to gangrene. In the treatment the injured vessel should be immediately exposed and an attempt made to suture it. The author has seen a case of gangrene of the upper extremity as a result of fracture of the middle third of the humerus with injury to the brachial artery.

---

[1] Eichhoff, E.: Zentralbl. f. Chir., 53, 2706, October 23, 1926.

[2] Gregora, H.: Beitr. z. klin. Chir., 1927, 140, 199, 229.

Treatment.—Certain contusions, as those of the testicle, are accompanied by marked shock, and the first step in the treatment is to combat the shock by appropriate shock measures (see Chapter XXIV). After the shock, if any, has been dealt with the contused part must be put at rest. Contusion of the arm or hand calls for a sling. Contusion of the thigh or leg requires rest in bed. The affected part should be elevated to facilitate the reduction of the swelling. The early stages of contusion are benefited by application of cold. In the later stages heat, particularly moist heat, has been found beneficial in the absorption of the extravasated blood and lymph and the reduction of the swelling. The application of pressure is a useful first-aid measure in contusions *if* it is well tolerated by the patient. Pressure may be brought about by various methods. The time-honored cold table knife or cold spoon applied to the bruised forehead of a child has definite value. A snug bandage over a cotton pad or over a compressed wet marine sponge is useful. The weight of an ice-bag has some effect. Except in cases where there is extravasated large amounts of blood gentle massage is useful in removing the swelling. The massage should be of the lighter, stroking type with the movements directed centripetally, as regards the circulation.

Various external applications have been used, although their value is open to some question. Among these may be included ichthyol, lead acetate (dram 1 to a pint of water), 4 per cent. aluminum acetate, a solution composed of ammonium chloride, gr. xx, and tincture of opium and alcohol, each dr. j, and water, oz. 1; chloroform liniment; "iodex."

In the later stages of large hematomata it is wise to aspirate the fluid blood and put on a pressure bandage to bring about the obliteration of the hematoma cavity. A case in point is that of a workman who fell from a ladder, striking across his sacrum. A week later a large fluctuating swelling had developed. Aspiration of this cavity revealed in this case not blood but somewhat turbid serum. The swelling did not recur. Hematoma, if large, will often require a small incision with local anesthesia and evacuation of the clots, but this is done only with the strictest aseptic precautions.

The hematomata brought about by certain contusions occasionally are so painful as to require immediate aspiration. This is frequently the case with subungual hematoma. The various methods of draining a subungual hematoma will be described in the section on the extremities.

Certain hematomata such as following severe blows on the calf of the leg are accompanied by such profuse internal bleeding, with such marked distention of the calf, as to interfere with circulation. Here incision is required to find and control the bleeding point.

The prevention and treatment of blisters is a matter of considerable moment because of the frequency of this condition and the occasionally fatal result. Blisters most frequently occur about the feet when wearing new shoes or ill-fitting shoes. To those who anticipate that a blister may occur from pressure or rubbing or from an extraordinarily long walk, firm strapping with adhesive plaster of the endangered skin is an excellent prophylactic against the formation of blisters. Once the blister has formed the ideal treatment is to put the part at rest, treat the skin with an antiseptic solution, and cover with a sterile dressing. This, however, is generally impracticable and the treatment of choice is to aspirate the blister. With rigid aseptic precautions the skin should first be sterilized, the hands should be sterilized, and a sterile instrument should be used. A needle is satisfactory, but should be inserted in the skin just beyond the margin of the blister and the fluid expressed through the opening made (Fig. 364). A firm bandage is then applied. The detached epidermis will then dry and eventually scale off. Should infection occur beneath a blister, the separated epidermis should be removed and a mild antiseptic applied to the wound and a vaseline gauze or boric solution dressing used.

Severe contusions are often so painful that the use of morphine, codeine, and aspirin is required.

II. SPRAINS

Sprains may be defined as wrenches of joints, that is, minute traumata or ruptures of individual fibers or of small groups of fibers of the ligaments holding joints intact. Sprains are brought about by overstretching of these ligaments, as in falls or blows. All joints are subject to sprains. In some cases the ligaments about a joint are so extensive that the part involved may be over a considerable area. Sprains of the ankle, for instance, may not only involve the external lateral ligaments of the ankle-joints, but the ligaments on the dorsum of the foot as well.

Symptoms.—The symptoms of a sprain are immediate pain, rapid effusion of lymph, and occasionally of blood, in the neighborhood of the ligament involved and into the joint. Very familiar is the rapid painful swelling following a sprain of the ankle or sprain of the finger. A further important symptom is the inability to completely use the joint. Those motions of the joint which require the use of the affected ligament are extremely painful, and one of the diagnostic tests of a sprain is that tension put upon the injured ligament is painful and tension put upon the opposite ligament with relaxation of the injured ligament is not painful.

Treatment.—The treatment of sprains is extremely varied, according to the individual treating the patient. Trainers and rubbers on athletic fields often employ widely different methods to their own satisfaction. The principles which should underlie rational treatment of a sprain are first, rest of the affected ligament and the muscles or tendons which may be attached to it; second, measures directed toward improving the circulation, as heat and gentle massage or contrast baths, in the severe cases repeated aspirations of joint effusions, and gradual but early resumption of use. McWilliams[1] believes that a further important object is the elimination of the effusion which separates the torn edges of the tissues. He believes that recovery is hastened by: "(1) Placing a firm pad of gauze over the area of effusion and firmly strapping this on by strips of adhesive plaster. This acts to facilitate the absorption of the fluid, as well as making a local splint for the injured fibers. (2) By a similar pad and strapping placed on the tendon just above the inflamed area. Jones says that this acts as a stop, preventing the tension on the muscle from being transmitted in its full force to the injured attachment. . . . Every workman who puts a strap around his wrist to ease a strained tendon is putting this procedure in practice. Jones adds, the wonder is that so few surgeons apply it to the deltoid, the quadriceps, the ankle, foot, hand, and wrist. The strapping should be put on so extensively that no motion will come upon the injured muscle or tendon when active motions, such as walking, are attempted. If such motions cause pain, additional strapping should be put on until there is no pain. Lighter and lighter strapping should be put on until active motions to the full unrestricted extent are possible without pain or a feeling of weakness. This may take two or three weeks." The treatment of individual sprains will be considered in individual sections.

III. STRAINS

A muscle may not inaptly be likened to a large cable such as is used in towing an Atlantic liner. The fibers of the muscle correspond to the individual fibers of the cable. Extreme tension upon a cable may cause the parting or rupture of certain strands or fibers in that cable without the parting of the cable itself. Similarly, in a muscle which has been overstretched certain muscle-fibers will rupture or part without the muscle itself tearing across. With the rupture of these individual fibers hemorrhage occurs with pressure upon the adjacent intact fibers. The result is pain and limitation of function. A very common example of this is in certain types of "tennis leg," "rider's thigh," etc. In "tennis leg" the entire plantaris muscle may be ruptured or merely certain fibers of the gastrocnemius or soleus muscles.[1]

---

[1] McWilliams, Clarence A.: Lewis' Practice of Surgery, vol. ii, chap. 5, p. 42.

Treatment.—It was formerly thought that cases of "tennis leg" and other ruptured muscle-fibers required complete immobilization for treatment, and the condition was treated with great respect because of the great length of time required to bring about healing. Cases of "tennis leg" which were put in plaster casts did not recover for many months. A certain English writer[2] discovered that those of his patients who neglected to follow his instructions as to extreme rest recovered more rapidly than those who immobilized the muscle. He felt that this phenomenon was due to the fact that in the immobilized muscle scar tissue developed at the site of the minute hemorrhages and that painful adhesions occurred between the adjacent muscle-fibers. Accordingly, the modern treatment of strains of muscles is as follows: If the pain is very severe the patient must be put to bed with the part elevated at rest and subjected to hot fomentations. As soon as is possible the patient is encouraged to use the muscle in increasing amounts. Not infrequently a valuable adjunct to the treatment is the application of a snug bandage over the affected area. Gentle and skilful massage will further hasten the recovery.

No longer

IV. DISLOCATIONS

Dislocations or luxations are a disturbance of the normal joint relationships. By reason of direct or indirect violence such injury to the supporting ligaments of the joint has occurred as to permit an adventitious movement of one or more of the bones comprising the joint. In dislocation one or more of the joint surfaces are out of their normal positions.

Dislocations are promptly followed by a large serous and occasionally sanguineous effusion into the joint cavity and often into the adjacent soft parts. Joints vary considerably in their liability to dislocation. The shoulder-joint with the shallow glenoid cavity of the scapula comprising such a small part of the joint mechanism is particularly liable to dislocation. The elbow-joint, the ankle, and knee are less commonly affected, and, least of all, the hip-joint with its deep acetabular fossa and its extremely strong supporting ligaments. Stimson[1] notes that the proportion of dislocations to fractures is as about 1 to 10. This author gives the following table of dislocations at the Hudson Street Hospital, New York, 1894–1905.

---

[1] Christopher, Frederick: Early Mobilization in Tennis Leg. Med. Jour. and Record, June 1, 1927.

[2] Hood, Wharton P.: The Treatment of Injuries (quoted by Binnie).

Hip, dorsal	19	
Thyroid	3	
Knee	12	
Semilunar cartilage	13	
Patella, outward	9	Lower extremity, 89
Head of fibula	1	5.825 per cent.
Ankle	5	
Astragalus	5	
Subastragaloid	5	
Metatarsus and phalanges	17	
Clavicle, outer end	69	
Sternal end	12	
Shoulder	617	
Elbow	156	
Head of radius*	18	
Ulna, upper end*	13	
Lower end	8	Upper extremity, 1368
Carpus	7	89.59 per cent.
Trapezium	1	
Semilunar	5	
Scaphoid	3	
Os magnum	1	
Metacarpal	80	
Metacarpophalangeal and phalangeal	378	
Lower jaw	61	
Vertebræ	6	Head and trunk, 70
Chondrosternal	1	4.58 per cent.
Sacro-iliac synchondrosis	2	
	1527	

* It will be noted that the shoulder was affected by far the most frequently. The next most frequent dislocations were the metacarpophalangeal and phalangeal, the elbow, the metacarpal, the clavicle, and the lower jaw.

Symptoms and Diagnosis.—Dislocations are painful, but the pain is rarely so severe as that of a fracture. The diagnosis is generally very easily made because of the abnormal appearance of a fresh dislocation and because of the limitation or absence of joint function. Dislocations of long standing may be difficult of recognition because of the swelling and the inability to recognize the joint landmarks. Such cases may require *x*-ray examinations for a diagnosis. Where possible all dislocations should be *x*-rayed before reduction. All dislocations should be *x*-rayed after reduction.

---

[1] Stimson, L. A.: Fractures and Dislocations, 7th ed., p. 473.

Treatment.—The most important single rule in the treatment of dislocations is that reduction should be effected as soon as possible after the accident. Untreated dislocations have been known to cause very serious results. The disarticulated part may cause severe pressure on the important artery in the region, and has on occasion actually brought about gangrene of parts distal to the occluded vessels. Certain dislocations do not properly belong to the subject of minor surgery, but most of them do, and will be taken up under the regional discussion.

V. SIMPLE FRACTURES

Simple fractures are solutions of continuity of bone without solution of continuity of the skin or mucous membrane. The term "simple" applied to a fracture refers to the absence of skin wound. Simple fractures may be exceedingly complex as to the difficulties attendant upon their reduction and after-treatment. Simple fractures may be complete or incomplete, may be fissured, may be greenstick, or they may be impacted. Fractures are brought about by external violence or by forcible muscular contractions. The external violence may be either direct or indirect. The various bones of the body vary considerably in their susceptibility to fracture. The following is a table taken from Stimson[1] indicating the frequency of fracture in the different bones:

Region.	Number of cases.	Per cent.
Head	772	5.50
Face and neck	1,281	8.79
Trunk	1,832	12.57
Upper extremity	6,818	46.80
Lower extremity	3,863	26.54
Total	14,566	100.00

These 14,566 fractures were treated at the Hudson Street Hospital, New York, between 1894 and 1905. The more common among them in order of frequency were: Phalanges, 1990; ribs, 1675; Colles' fractures, 1212; ankle fractures, 1089; metacarpus, 1063; tibia, or tibia and fibula, 943; cranium, 772; nasal bones, 672; clavicle, 662.

Symptoms.—The symptoms of fracture are: first, pain; second, swelling; third, limitation of function. Deformities may or may not be present. Ecchymosis generally is present after the second day. Modern diagnosis of fractures has rendered obsolete the sign of elicitation of crepitus. With the history of an injury, with pain and the abnormal appearance of the extremity, *x*-ray examination should at once be made without painful palpation of the affected region. If the appearance be normal, but there is a tender area of the bone, *x*-ray examination should be made.

---

[1] Stimson, L. A.: Fractures and Dislocations, 7th ed., p. 19.

Treatment.—The subject of fractures includes some of the most difficult and the most involved treatments in the realm of surgery. The treatment of fractures of the femur, depressed fracture of the skull, compound fractures of the tibia and fibula, certain fractures of the spine, for example, do not belong to the domain of minor surgery. On the other hand, however, a very large number of fractures may be classed as minor fractures. They are, generally speaking, the fractures which are treated in the office and out-patient practice, and which require but little apparatus and but few assistants to insure a good functional recovery. These minor fractures will be discussed in the sections which follow dealing with various regions of the body.

VI. LACERATIONS OF INTERNAL ORGANS

Lacerations of internal organs properly come under the heading of closed wounds. In no case, however, is it proper to include them in minor surgery.

CHAPTER II

OPEN WOUNDS

Open wounds are tissue injuries which are accompanied by a break in the skin or mucous membrane and may be classified as follows:

1. Incised wounds (including stab wounds).
2. Lacerated wounds:
    - (*a*) Abrasions.
    - (*b*) "Brush burns."
    - (*c*) Punctured wounds.
    - (*d*) Penetrating wounds.
    - (*e*) Contused wounds.
    - (*f*) Avulsions.
    - (*g*) Wounds of joints.
    - (*h*) Compound fractures.
    - (*i*) Insect bites and snake bites.
3. Wounds produced by chemical and thermal agents.

Incised wounds are those which are made by cutting instruments, as knives, razors, glass, etc.; the edges are uniform in outline and may be readily coapted. Stab wounds are those which are made by long sharp instruments as daggers, bayonets. **Lacerated wounds** are those with torn or uneven edges. **Abrasions** constitute merely those wounds in which there is a separation of the superficial layers of the epithelium and in which there is an effusion of serum or a small amount of capillary bleeding. **"Brush burns"** are wounds which have been made by rapid passage of abrading surfaces across the skin, for example, as in a man sliding down a rope with tightly closed hands. **Punctured wounds** are those in which the orifice is relatively small compared to the depth of the wound. These are generally made by sharp, blunt objects, such as nails, sharp stones, and also by missiles and blank cartridge waddings. The punctured wounds are of particular importance to the surgeon because of the fact that the entrance rapidly seals over and the depths of the wound which have been invaded by the nail or missile are excellent soil for anaërobic organisms. These organisms may have been upon the clothing or body surface or upon the wounding agent. The latter may implant them in the depths of the wound. Moreover, punctured wounds often bring about the lodgment of ordinary pyogenic bacteria at a depth where drainage is difficult. By **penetrating wounds** is meant wounds which involve a hollow viscus or internal organ of the body. **Contused wounds** are those in which the edges of the wound are crushed and devitalized. **Avulsions** are wounds in which a section of the tissue is actually torn away, as avulsions of the scalp and avulsion of an extremity. **Wounds of joints** deserve especial mention because of the fact that the admission of bacteria into the joint cavity has a particularly serious significance. **Insect bites** and **snake bites** are minute wounds which are complicated by the introduction of a poisonous substance into the wound in addition to bacteria.

Chemical agents may be the cause of wounds. Strong alkalies, such as sodium hydroxide, and strong acids, such as sulphuric and nitric acids, will destroy various depths of the skin and form portal of entry for bacteria. Lye when swallowed will cause a wound of the esophagus which is of importance because of the resulting scar formation. Bichloride solution will cause necrosis of the tissues with which it is in contact.

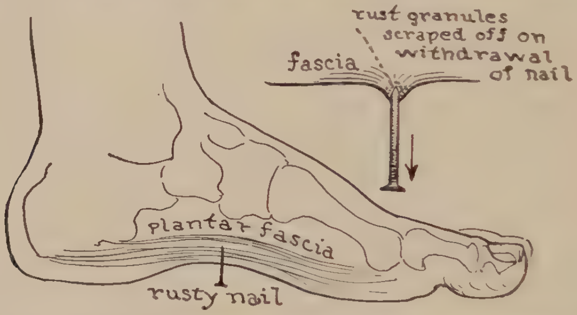

Fig. 1.—Puncture wound of the foot, showing the danger of rust granules being scraped off by the plantar fascia.

Extremes of temperature (**thermal agents**) are likewise sources of wounds. Frost-bite, or freezing by ethyl chloride solution, will cause necrosis of the superficial layers of the tissues and will bring about a wound. Burns varying in intensity by varying agents will likewise cause wounds.

Many wounds if unattended will heal spontaneously. Intelligent treatment, however, will greatly minimize the danger of serious complications and will accelerate the healing time immeasurably. Neglected wounds invite propagation of bacteria and their dissemination to deeper portions of the adjacent tissue. Lack of treatment or faulty treatment involves far greater pain to the patient and prolongs the period of morbidity.

TREATMENT OF OPEN WOUNDS

(*a*) **Prophylactic Treatment and First Aid.**—Modern industry has been quick to realize the importance financially and sociologically of protecting its employees from injury. Protective devices of all kinds have been installed in industrial plants and an active campaign of education has been carried out among the employees. Furthermore, an elaborate system of first-aid treatment has greatly reduced the number of days of time off of injured employees. The smallest abrasions are immediately painted with tincture of iodine or mercurochrome. De Tarnowsky[1] wisely says, "It is axiomatic that illogical, unclean, or meddlesome 'first aid' is more dangerous to the patient than no treatment at all. The hemorrhage of an incised wound cleanses the latter much more effectively than clumsy scrubbing of the area, and the magic of iodine will not offset the introduction into the devitalized muscle tissue of bacteria normally inhabiting the skin as saprophytes." The wound edges, not the depths of the wound, should be swabbed with the antiseptic.

Safety campaigns in matter of automobile traffic have as yet been somewhat unsuccessful in reducing the number of accidents brought about in this manner. Railroad travel, however, has become a matter of such extreme safety that the ratio of accidents to the number of passengers carried is extremely small. Better aëroplanes, better pilots, and more strict government regulation have made aviation a great deal safer. The number of casualties to the number of miles traveled is small. Athletics and vigorous games, rather than bringing about more injuries, have developed bodily skill in the individuals to the extent that they are less liable to incur injuries.

The *first-aid treatment of minor wounds* should intelligently be carried out in the home as well as in business. It should be the duty of every physician to instruct such families as come under his care in the everyday measures of home first aid. Insignificant abrasions of the elbows and knees in children often develop into lymphangitic infections. Neglect of blisters has had fatal results. In every household it should be the watchword that a slight break in the skin should be treated with an antiseptic, preferably mercurochrome (2 per cent.) or tincture of iodine, and covered with a protective dressing. The dressings of these abrasions need not be changed for several days unless they become infected, in which event, saturated solution of boric acid as a wet dressing, or a mildly antiseptic ointment, as mercurochrome ointment or boric ointment, will be of service.

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[1] De Tarnowsky, George: Emergency Surgery, Lea & Febiger, Philadelphia and New York, 1926.

Walter[1] recommends the use of an aqueous solution of tannic acid not only for burns but also for surfaces denuded by other traumata. He claims that the method is of value from the standpoint of simplicity, comfort, freedom from painful dressings, quick healing, and lightness of the scar.

(*b*) **Immediate Treatment.**—1. *Shock and Syncope.*—In minor surgery the injuries are rarely of such severity as to bring about a condition of shock. However, it is a familiar fact that vaccinations or hypodermic injections will often cause strong men to lose consciousness. A small bleeding wound not infrequently has the effect on the affected individual of bringing about a condition of mild shock. It is important in these cases immediately to use ordinary antishock measures. The head should be lowered either by having the patient bend over in his chair so that the head is between the knees, or by having him lie down. Inhalation of aromatic spirits of ammonia by saturating a gauze sponge and applying to the nose is very beneficial. Administration of aromatic spirits of ammonia by mouth has not been found to be very satisfactory, as it often causes nausea and vomiting. A drink of whisky, *if obtainable and if given to a person who is accustomed to its use* is beneficial. In cases

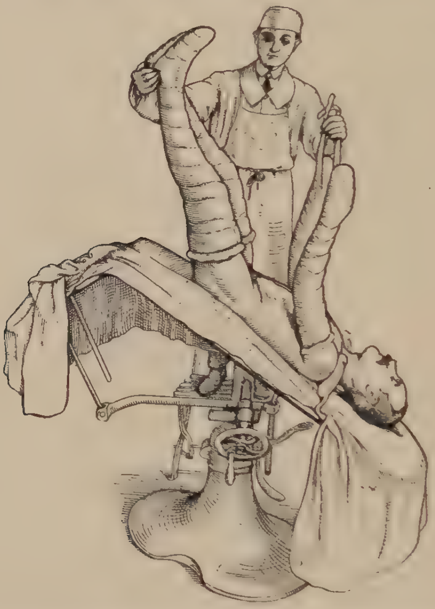

Fig. 1a.—Treatment of shock by elevation and bandaging of the extremities. (Maisonnet, "Petite Chirurgie," after Rochard and Stern.)

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tection

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[1] Walter, A. B.: Canad. Med. Assoc. Jour., 1927, 17, 1517.

of extreme shock in major injuries it will be necessary to elevate and bandage the extremities (Fig. 1a), to administer fluids by hypodermoclysis ?? and by proctoclysis, to give blood transfusions, and to administer stimulating drugs, as caffeine sodium benzoate, grains 7½, and camphorated oil. Infusions of saline or Ringer's solution may occasionally be required.

2. *Control of Hemorrhage.*—The most important and the most valuable single measure in the control of hemorrhage is direct pressure upon the bleeding point. Save in cases where a large artery has been severed, pressure on the bleeding point will bring about occlusion of the bleeding vessel and the formation of a protective thrombus or clot. In an emergency patients will telephone a doctor in regard to bleeding which they consider extremely serious. The physician can accomplish a great deal of good by instructing them firmly to apply a sterile compress to the bleeding point or, failing a sterile compress, simply a clean cloth. The pressure should be continuously applied until the hemorrhage has subsided. Anxious patients will often remove the pad too frequently and not afford a chance for the clot to form.

Elevation of the affected part will lower the blood-pressure, both arterial and venous, to such an extent that bleeding will be greatly diminished. Where the proper facilities present themselves and where an isolated bleeding vessel may be found, the grasping of the bleeding vessel by a hemostat or artery clamp and ligating it is the most efficacious way of controlling bleeding. However, in the wounds of minor surgery this rarely is required. Wounds of the scalp bleed very profusely and it is a common experience of interns and others to spend considerable time attempting to isolate the bleeding point, clamp, and ligate it. A much better procedure is the suture of the wound itself, taking deep bites in the skin, and the application of a firm dressing over the wound. Large oozing surfaces of capillary bleeding are best controlled by the application of hot packs. Small wounds, as razor cuts and small abrasions, may have their bleeding stopped by pressure or by application of styptics, such as alum, tannic acid, ferric chloride, or by coagulating agents, such as "thromboplastin."

In *hemophilia* there is prolonged clotting time of the blood. This disease, which is hereditary, is transmitted only by the female and occurs almost exclusively in the male. According to Minot and Buckman,[1] pin pricks do not cause bleeding, but scratches may initiate serious hemorrhage. The veins and ears may thus be punctured with impunity, indicating that the bleeding time is normal. These authors say that the disease tends to become fatal before the subject attains adult life. In cases of hemorrhage in individuals with hemophilia absolute quiet is essential. Locally tissue-juice extracts should be applied. Fresh meat tissue is serviceable in an emergency. "Thromboplastin" (Parke, Davis & Company) and styptics should be tried. Weil[1] says that the most reliable method of controlling hemorrhage in wounds and bleeding surfaces is the use of compression gelatin bandages and compresses soaked in fresh normal blood-serum. For this purpose a bandage is soaked in sterilized gelatin (2 per cent.) and is applied to the bleeding parts under pressure. "Fibrogen" (Merrill) should be given orally and hypodermically. Injections of thromboplastin may be of use. In severe cases blood transfusions may be a life-saving measure. It will not only replace the lost blood but will supply coagulants. Minot and Buckman says "The use of protein sensitization in the treatment of hemophilia is noteworthy. The *non-sensitive* patient is given 3 to 4 c.c. of sheep or horse serum subcutaneously. After ten days he will usually be sensitive and should then receive about 0.2 c.c. of the same serum intradermally. As the skin reaction becomes positive, the coagulation time of the blood often falls, and if bleeding is in progress it will probably stop. The effect may last for days or many weeks. The skin reaction does not desensitize the patient, so that he is constantly ready to react to other intradermal injections of the protein solution. These may be given as often as desired to check the bleeding when it arises."

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[1] Minot and Buckman: Cecil's Text-book of Medicine, W. B. Saunders Company, 1927, p. 959.

Every Boy Scout troop and first-aid class throughout the country has been religiously drilled in the application of *tourniquets*. In the average man the sight of blood invariably invokes the idea of a tourniquet. As a result, the tourniquet has been perhaps much misused and done more harm than actual good. The venous pressure, being about 8 cm. of water, is greatly lower than the arterial pressure, which, in the average, is from 110 to 180 mm. of mercury. The commonest error is to put on the tourniquet tight enough to overcome the venous pressure but not the arterial pressure, and as a result the bleeding is, and continues to be, more profuse than before the tourniquet was applied. It is a common experience of physicians on arriving at the scene of an accident to remove such a tourniquet and, to the astonishment of those present, see the bleeding stop. Moreover, all such bleeding could have been controlled merely by pressure. A second error in the application of the tourniquet is its too tight application. The resulting pressure upon the nerve trunks will bring about a paralysis which fortunately generally is only transitory. Where it is necessary to use a tourniquet, as in such operations as require a bloodless field, a blood-pressure apparatus is far superior, as the actual pressure may then be measured. There are very few uses for the tourniquet in minor surgery. In first-aid work its use is reserved for such major accidents as traumatic amputations of extremities, where a large artery, such as the femoral or the brachial, is bleeding. In this case any material, such as a belt, handkerchief, a rope or a cord, should be twisted about the extremity proximal to the bleeding point and tightened up until the bleeding ceases. In such cases it is advisable momentarily to release the tourniquet every hour to flush the parts distal to it with blood, and thus to lessen the danger of gangrene in tissues which might be saved.

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[1] Weil: Serotherapie d l'hemophilie, Compt. Rend. Acad. des Sci., cxli, 15, quoted by Matas, Keen's Surgery, vol. v, p. 214.

3. *Anesthesia.*—Many minor surgical wounds may be treated without anesthesia. In most adults of stable temperament the introduction of a few sutures with a sharp cutting needle and fine suture material is well borne. In young children, however, and nervous adults some form of anesthesia will be necessary. In children with wounds about the face, where immobility is necessary for accurate suturing, a general anesthesia is preferred. In adults local or general anesthesia may be used. The use of local anesthesia should be more generally employed. Its omission generally indicates that the physician is unprepared to administer it or is too lazy to do so. To be skilfully done requires the finest type of needles. A No. 27 gage hypodermic needle with a *short* bevel may carefully be inserted into the skin at the margin of the wound and the skin and subcutaneous tissues carefully infiltrated (Fig. 2). The suturing then may be accomplished without any discomfort on the part of the patient.

For a more detailed account of local anesthesia see Chapter XXIII.

4. *Cleansing and Preparation of the Wound.*—The proper cleansing and sterilization of the wound is of great importance. Time spent in this activity will well reward the surgeon. It is advisable to cleanse the neighborhood of the wound with green soap and water, cleansing that part which is closest to the wound last and with fresh gauze and soap. If it can be done without too much trouble, grease if present, should be removed by means of benzine and alcohol. All hair for an area of at least 2 inches about the wound should be removed. This is best done by first clipping with a scissors and then shaving. On the scalp a border of 2 inches will not be necessary, but $\frac{3}{4}$ inch to an inch of bare skin is advisable. In cases where there be a large amount of dirt and foreign material in the wound itself, this should be scrupulously removed, if

necessary, under general anesthesia. The removal of this dirt from the depths of the wound may start up again bleeding which has subsided, but this evil cannot be avoided. Certian cases, where the face has been forcibly ground into gravel or cinders, will have these minute foreign particles intimately embedded in the skin. If possible, all of these should be removed. It is sometimes impossible to remove these particles entirely and a more or less permanent discoloration will take place. In a case of powder grains likewise removal is desirable. Some authorities advise general anesthesia and the scrubbing of the wound surface with a stiff brush dipped in peroxide of hydrogen. Pieces of glass or porcelain tile or other foreign bodies should be searched for with moderate degree of throughness. A vigorous probing and upheaval of the wound is not good technic. The removal of embedded foreign bodies will be dealt with in a separate section.

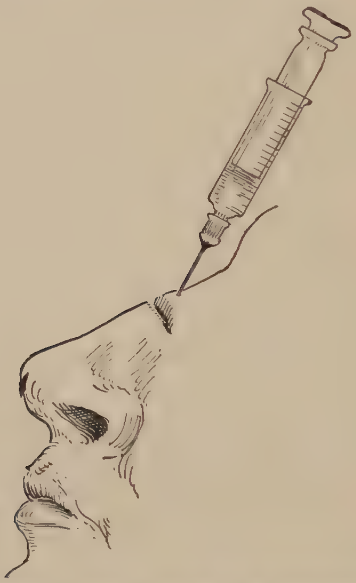

Fig. 2.—Method of infiltrating a wound with local anesthetic solution preparatory to wound suture. The solution is injected into the intact skin with a very fine needle.

5. *Antiseptics.*—After the skin and parts adjacent to the wound have been cleansed, an antiseptic should be applied into the wound and liberally about the neighboring skin. A large number of antiseptics have been used by various workers, and each man is apt to have his own favorites. It is not unlikely that the thoroughness with which the preliminary cleansing is done is more important than the antiseptic used. Unfortunately complete reliance cannot be placed upon any chemical

skin sterilization. Tinker and Sutton[1] have called attention to the inefficiency of most of the common antiseptics. These authors note that serious infections in clean wounds are by no means a thing of the past even in the best hospitals, and that bacteria can be grown almost invariably from skin prepared by antiseptics. Study of over 1550 cultures showed that iodine, trinitrophenol, Harrington's solution (commercial alcohol [94 per cent.], 640 c.c.; hydrochloric acid, 60 c.c.; water, 300 c.c.; corrosive sublimate, 0.8 gm.), mercurochrome 220 soluble, and potassium mercuric iodide will not kill most of the resistant, and some of the less resistant, pathogenic bacteria under conditions of perfect contact, and are still less efficient if penetration is required. In 1926 these same authors[2] concluded that the superficial and deeper layers of the skin of protected areas in cleanly individuals are frequently free from bacteria. If the skin be smeared with resistant non-pathogenic bacteria, soap and water scrub alone will make it free from bacteria in 30 per cent. These writers praise 5 per cent. acriflavine, but believe that the older relatively efficient antiseptics should not yet be discarded. In this connection the observations of Meader and Fevier[3] are of interest. They observed drug fastness to have been developed in one strain of Bacillus typhosus, three strains of Bacillus coli, and one strain of Bacillus lactis aërogenous to silver nitrate, mercurochrome, formaldehyde, acriflavine, hexylresorcinol, and phenol. *Tincture of iodine* has stood the test of time as a useful antiseptic. It is first applied to the dry skin around the wound, and then is thoroughly insinuated into the depths of the wound by a fresh application. *"Colloidol" iodine* is a dry water-soluble iodine preparation. It is prepared in the trade (Merck & Company) in the form of colloidal iodine tipped applicators. The tip is moistened with water and rubbed over the water-moistened surface which is to be painted. "Free" iodine is liberated. However, the pain occasioned by the use of iodine is a distinct disadvantage, particularly when dealing with children or nervous individuals.

Webb[4] deprecates the use of iodine. Since 1926 he has discontinued the use of iodine in the first-aid kits of the Great Northern Railway and has substituted 2 per cent. mercurochrome, with satisfactory results. He warns against the use of iodine by the laity, and in industry the alcohol evaporates as the solutions become old, and the concentrated solution has caused severe damage to the tissues and may even result in hospitalization. Moreover, the laity frequently reason that "if a little is good, more must be better" and by repeated applications of iodine cause severe burns. For the sterilization of small wounds a 2 per cent. aqueous solution of *mercurochrome* has given equally good results. This solution has ready penetration and a high germicidal activity. It has low toxicity. According to De Laureat,[1] if 2 ounces of 2 per cent. solution be swallowed only a stomatitis or diarrhea would be the worst result. Riggs[2] has had excellent results with the 1 per cent. aqueous solution of mercurochrome in traumatic surgery. Smith of Wausau, Wisconsin, and C. B. Davis of Chicago believe that there is some danger in the local use of mercurochrome. The mercurochrome solution does not have the coagulating effect that alcoholic tincture of iodine has and seems more readily to combine with the tissue fluids. Simmons[3] found that a 3.5 per cent. alcoholic solution of iodine is more actively bactericidal on unbroken skin than any of the mercurochrome solutions which he tested. Rodriguez[4] considers that the 2 per cent. solution of mercurochrome is too feeble an antiseptic to be used safely as a surface disinfectant of the oral mucous membranes. A very excellent variation of the mercurochrome solution is the *mercurochrome-acetone-alcohol solution.* This solution was described by Scott and Hill,[5] who state that it is prepared by dissolving 2 grams of mercurochrome in 35 c.c. of distilled water, to which solution are added 55 c.c. of 95 per cent. ethyl alcohol and 10 c.c. of acetone. Hugh Young[6] says that the quick drying preparation which is thus obtained has been shown to sterilize the skin rapidly, to be non-irritating, and to penetrate the skin "fully as well as picric acid and better than kalmerid (proprietary 1 per cent. solution potassium mercuric iodide in 80 per cent. acetone) or tincture of iodine." He further states that according to Traut this solution of mercurochrome penetrates the hair follicles and the deeper layers of the corium. Scott and Hill say that this solution will not cause dermatitis regardless of the age of the patient or the location of the operative field. The solution retains its high bactericidal properties at least forty-six days. It has low toxicity and its stains may be removed by Dakin's solution or acid alcohol. Scott and Hill[7] say that "because of the low toxicity of the drug for normal tissue, it is possible to wash the wound with the solution before closing, and in this manner kill any bacteria that are introduced during operation." This solution will adhere to the skin as iodine, and its deep stain readily enables one to see the area which he has painted. An equally potent and perhaps less expensive antiseptic is a 1 : 2000 aqueous solution of "*metaphen*." This has a pale yellow color, but is somewhat less satisfactory to use on this score. It possesses unusually high bactericidal properties, especially when left in contact with micro-organisms for more than one hour.[1]

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[1] Tinker, M. B., and Sutton, H. B.: Jour. Amer. Med. Assoc., 87, 1347, October 23, 1926.

[2] Tinker, M. B., and Sutton, H. B.: Ann. Surg., 82, 640, 1925.

[3] Meader, P. D., and Fevier, W. A.: Jour. Infect. Dis., 39, 237, September, 1926.

[4] Webb, R. C.: Chief Surgeon of the Great Northern Railway, personal communication.

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[1] De Laureat, B. J.: New Orleans Med. and Surg. Jour., 80, 190, September, 1927.

[2] Riggs, T. F.: Of Pierre, South Dakota Surg. Jour., January and February, 1927.

[3] Simmons, J. S.: Jour. Amer. Med. Assoc., 91, 704.

[4] Rodriguez, F. E.: Jour. Amer. Med. Assoc., 91, 708.

[5] Scott, W. W., and Hill, J. H.: Jour. of Urol., 14, 135, August, 1925.

[6] Young, Hugh: Young's Practice of Urology, W. B. Saunders Company, p. 246, 1926.

[7] Scott, W. W., and Hill, J. H.: International Surgical Digest, 3, 195, April, 1927.

Solution S. T. 37 (*hexylresorcinol*) has recently been highly praised, and is now being quite frequently used at some of our best hospitals. Leonard and Feirer[2] have found that a solution containing 30 per cent. of glycerin and 70 per cent. of water in which is dissolved 1 mgm. of crystalline hexylresorcinol per cubic centimeter, possessed a surface tension of thirty-seven dynes per centimeter (solution S. T. 37). They found this to be the optimum composition of the solutions which they investigated for the following reasons: 1. It is stable and non-toxic. 2. All the major types of pathogenic organisms are destroyed in less than fifteen seconds on contact with this solution. 3. Its bactericidal power is fully retained (fifteen-second standard) in dilutions which are absolutely devoid of irritant action on the most delicate tissue surfaces. 4. Its bactericidal power is fully retained (fifteen-second standard) in all dilutions likely to be encountered in clinical applications as well as those found in the presence of organic matter. 5. The hexylresorcinol is held in perfect solution in all dilutions. 6. The surface tension of the solution is very low. 7. It is water clear and odorless. 8. It does not attack any of the heavy metals. Of less value is alcohol and ether, although in the absence of other remedies they are very satisfactory. Solutions of *acriflavine* (0.05 per cent.) and *trypaflavine* have given excellent results.[3] *Dichloramine-T* is also a valuable antiseptic. Adams[4] praises it after seven years' use. Bichloride solutions and carbolic acid *never* should be used. Their usefulness is limited to the sterilization of instruments; bichloride for silk catheters and bougies and carbolic acid for metal instruments. *Dakin's solution* is not suitable for a skin antiseptic because of its likelihood of causing irritation. Sladen[5] advised the following treatment of wounds: After cleansing the wound with soap and water and washing it with alcohol, every portion of the wound is pasted with "*bipp.*" The wound is then sewed up, painted with iodine, and covered with a dry dressing. The formula for "*bipp*" is as follows:

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[1] Raiziss, Z. W., and Severac, M.: Jour. Infect. Dis., 40, 447, March, 1927.

[2] Leonard and Feirer, W. A.: Surg., Gynec., and Obst., 45, 603, November, 1927.

[3] Graftdyk, C. J. v H.: Nederl. Maandschr. v. Geneesk, 13, 249, 1925; abstr. Jour. Amer. Med. Assoc., 86, 238, January 16, 1926.

[4] Adams, D. S.: Boston Med. and Surg. Jour., 194, 737, April 22, 1926.

[5] Sladen, R. J. L.: Indian Med. Gaz., 61, 113, March, 1926.

Liquid paraffin	Ounce j;
Bismuth subnitrate	Ounce j;
Iodoform	Ounces ij.

$MBGV_5$[1] is a solution containing 5 per cent. commercial methylene-blue crystals, 5 per cent. commercial gentian-violet crystals in 50 per cent. commercial grain alcohol. According to Roberts (*loc. cit.*) this solution kills common skin-contaminating organisms immediately, retains ability for sterilization at least two and one-half hours, is readily visible, is non-toxic and non-irritating to the skin, is stable for at least a month, does not intefere with reparative processes, and will not blister. Albrecht[2] reports very favorable experiences with the use of a halogen solution prepared by Ulzer of Vienna, from a mixture of iodine, chlorine, and fluorin salts. This preparatoin is hypertonic, weakly acid, and highly bactericidal. He has found it very useful in the treatment of suppurating wounds and gas gangrene.

6. *Closure of Wounds.*—The type of wound which requires suture varies with the judgment of the attending surgeon. By far too many wounds have been closed by stitches which would have healed equally well without. The pernicious practice of certain insurance companies of paying so much per stitch has induced men of a certain type to put in unneeded stitches. Scalp wounds in particular seem to be the pet subject for the introduction of sutures. Wounds of the scalp extending down to the periosteum and having a length up to 1½ inches will heal rapidly and cleanly if, after antiseptic preparations, a firm pad is bandaged in place. Many wounds of the extremities of a length up to 2 or 3 inches will heal satisfactorily with a pressure pad and bandage. There is no question, however, that in wounds on the face, where the minimizing of scar formation is the chief consideration, careful suture with early removal is indicated even for very small wounds. The accurate closure of a wound, however, is an excellent protection against invasion by pathogenic bacteria. Wright[3] says that "the natural uncorrupted blood fluids are competent to keep saprophytic microbes at bay and to preserve the wound against putrid infections; but these

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[1] Roberts, Kingsley: Ann. Surg., 89, 183, February, 1929.

[2] Albrecht, P.: Zentralbl. f. Chir., 1928, 55, 115, 120.

[3] Wright, A.: Practitioner, 114, 317, May, 1925.

uncorrupted body fluids will, when they collect in the wound, furnish a favorable nutrient medium for serophytic bacteria. The additions to trypsin, such as are furnished by disintegration of leukocytes, corrupt the wound discharges and convert these into an ideal cultivation medium for serophytic and serosaprophytic organisms indiscriminately. By artificial closure the wound is promptly sealed, with the result that the bacterial infection is rapidly extinguished and the formation of scar tissue avoided. In a 'wholesome wound' close in order to sterilize."

A word of particular warning must be spoken of the increased risk incident to the closure of wounds which communicate with bursæ or tendon sheaths. A common place for such a wound is over the olecranon bursa. A case in point is that of a man who had a 1-inch wound of the olecranon bursa neatly sutured. Forty-eight hours later he had a virulent streptococcic infection which involved the entire forearm, requiring subsequently many incisions of the forearm and eight or ten weeks of morbidity before complete recovery was effected. It would have been far better to have left this wound wide open. The chief factor is probably that of sterilization rather than the anatomical structure. Bursæ are difficult to sterilize when once they have been contaminated. However, in some cases where the wound has been thoroughly irrigated with mercurochrome solution, closure is permissible. These cases should be watched with particular care, and at the first sign of local infection or systemic disturbance the stitches should be removed and the wound opened freely. Moreover, it is advisable not

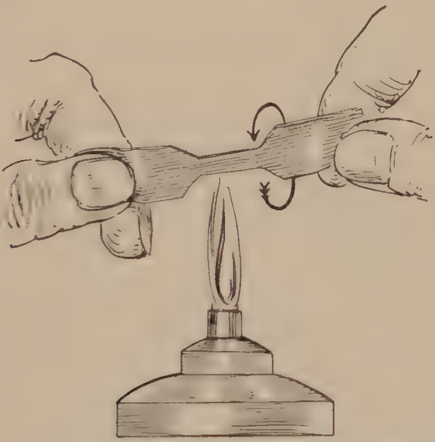

Fig. 3.- Adhesive for approximation of wound edges. The adhesive is cut in a dumb-bell shape so that the narrow central portion does not exceed $\frac{1}{4}$ inch in width. It is flamed on both sides over a Bunsen burner or spirit lamp.

to close a wound for the purpose of controlling hemorrhage from its depths. A large hematoma invariably will result and the danger of infection and the length of disability is greatly increased. A wound should never be closed until bleeding is accurately controlled.

Many small wounds may be closed very satisfactorily by the use of adhesive plaster. It is important to cut the pieces of adhesive plaster in a somewhat dumb-bell shape (Fig. 3) so that a very small width of adhesive plaster crosses the wound and yet a large surface of adhesive is applied to the skin to give adequate traction (Fig. 4). If the width of adhesive crossing the wound be narrow, and applied at several intervals, ample exit for the wound secretion is provided, and infection is very unlikely. A wound of the forehead, 5 inches in length, was beautifully coapted by adhesive bridges with no infection and a minimum amount of scar.

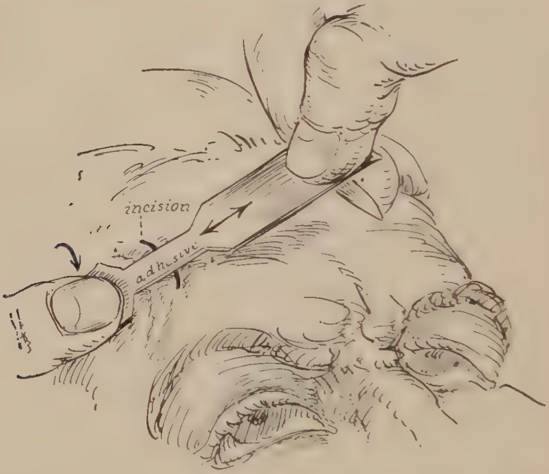

Fig. 4.—Application of "dumb-bell" adhesive to a small wound. The adhesive has been flamed on both sides. The adhesive is fixed on one side first and is then drawn toward the other, thus approximating the wound. The central portion should be somewhat smaller than is shown in the figure.

The indications for suture of a wound are, first, the necessity for very accurate approximation, as on the face, where even wounds of very small size may require suture, and second, in wounds of large size, the prevention of infection and the acceleration of healing. Once decision to suture has been reached, the proper instruments and material must be selected. For wounds on the face, small curved, sharp cutting needles, with a radius of $\frac{1}{4}$ to $\frac{1}{2}$ inch should be employed. A small needle holder and an extremely small tissue forceps with teeth, such as is used in ophthalmology, are of value. A very fine suture material should be used; for this purpose, the so-called "dermal suture," horsehair or very fine silk, is the best. The sutures should be accurately placed (Fig. 5), so that an equal bite is taken on each side of the wound. They should not be tied too tightly and great care should be taken to see that the skin edges are not inverted. On the face, half of the sutures may be removed at the end of twenty-four hours and the other half at the end of forty-eight, unless there is special reason to the contrary. Where there is great strain on the suture line, as over the prominences of joints, it will be advisable to introduce tension sutures to take the strain off the wound suture line. Do not hesitate to remove a suture and reinsert it if you feel that the coaptation is not accurate. In small wounds sutures which do not penetrate the entire thickness of the skin will leave a minimum amount of scar.

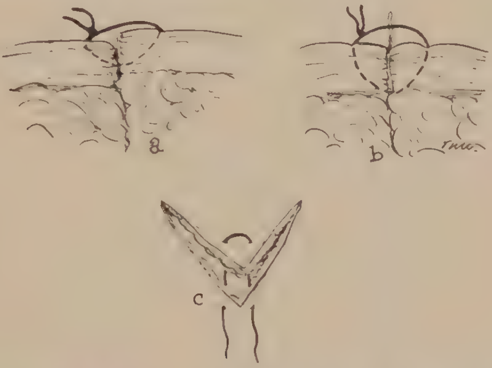

Fig. 5.—Introduction of wound sutures: *a*, Improper method; close coaptation of skin edges not effectsd. *b*, Correct method of placing sutures. *c*, Suture of an angular wound. (After Moorhead.)

The use of Michel clips as advocated by many has a distinct usefulness. With the proper instrument for introducing them (Figs. 6, 7) they may be applied with less pain than is necessary in the taking of stitches, and with the aid of the clip remover (Fig. 8) they can be removed almost painlessly. They require, however, some skill to put in and need perfect quiet on the part of the patient. For this reason they are rather unsuitable for a nervous, crying child.

The use of hair knots, which has been mentioned in the literature, and which consists in tying together with hair on either side of the wound, is mentioned only to be condemned. In cases of ragged wounds with devitalized and irregular edges the latter should be trimmed off. Most severe cases are left wide open and the Carrel-Dakin treatment instituted. Small ones which have been thoroughly cleansed may be sutured. Small muscle wounds are best left unsutured. Mattress sutures of loosely tied chromic catgut with drainage of the wound will be advisable in the more extensive cases.

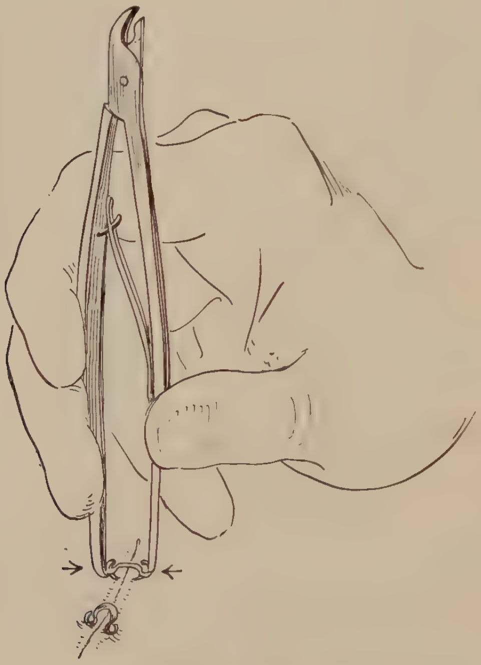

Fig. 6.—Wound closure by Michel clips. The wound edges are approximated by two mouse-toothed forceps, or the incision is stretched lengthwise by two Allis clamps. The clips are introduced by the special clip holder. The skin edges must not be inverted. The clips will go in more readily if they are slightly curved before they are compressed.

7. *Drainage of Wounds.*—A recently incurred wound of the scalp, face, or extremities which has been adequately cleansed and sterilized and in which hemorrhage has been controlled, need not be drained.

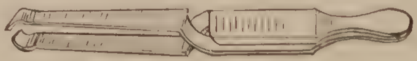

Fig. 7.—Specially designed Michel clip holder. Pressure on the proximal end divulses the blades; pressure on the distal end compresses the blades.

However, in particularly dirty wounds of large size, with extensive undermining of skin flaps or in which a continuous oozing of blood cannot be controlled, drainage is of first importance. For a very small wound, so far as drainage is concerned, several strands of silkworm-gut will serve admirably. In larger wounds, as, for example, where a flap of skin has been partially avulsed, drainage may be effected by using one-half of a rubber tube drain $\frac{1}{8}$ inch in diameter. The wound should not be tightly packed with gauze. Where the flap is greatly undermined it is useful to make a stab wound and draw this drain through the flap. The present tendency is toward the less frequent employment of drainage in fresh wounds which have been properly cleansed mechanically and chemically.

8. *Dressing of Wounds.*—The purpose of dressing of wounds is to prevent the invasion of pathogenic bacteria and to furnish a sterile absorbent for the normal wound secretion. In wounds of the face, particularly those in the vicinity of the mouth and the nostrils, where mucous secretion may readily contaminate the dressings or where food or fluids may inadvertently be spilled upon the dressings, the open air treatment is to be preferred. In this method no dressings whatsoever are placed upon the wounds, but the nurse or parent in charge of the case is instructed to gently sponge the wound with a cotton applicator saturated in boric solution at intervals of every fifteen minutes during the first six or eight hours. This procedure will remove the small amount of excess secretion and at the same time will apply a mild antiseptic to the wound surface. Where the open-air treatment is not to be used and a dressing must be applied, gauze is far more suitable than any other material. Cotton should never be used in direct contact with the wound, as its fibers become inextricably attached to the scab and are almost impossible to remove. A dry gauze dressing is generally the best pro-

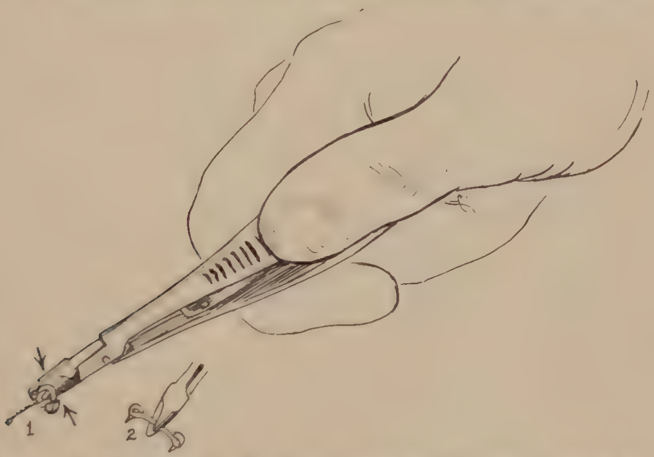

Fig. 8.—Removal of Michel clips. By closing the clip remover the prongs of the clip are spread apart and the clip is painlessly removed.

cedure. When the gauze dressing is removed at the first dressing, which generally is on the second or third day, it is important to remove it in a direction parallel to the wound (Fig. 9). Ill-advised traction on gauze over a wound at right angles to the wound direction not infrequently will open up a wound. Where there is particular necessity for the non-adherence of the dressing, sterile white vaseline may safely be used. White vaseline is preferable to medicated vaseline, particularly to carbolated vaseline, which never should be used. Moist boric dressings should not be employed on a freshly sutured clean wound. De Motte,[1] following an experience with 12,000 wounds, recommends moistening the dressing every two hours with hot water. Chambers[2] advises wet antiseptic dressings for the first twelve hours. The gauze dressing is preferably held in place by a bandage, which has the advantage of furnishing a moderate degree of pressure to the healing wound and is free from the disadvantage which adhesive has of painful removal. In small wounds, however, as on the forehead, where bandage is objected to on the score of appearance, the gauze should be fastened to the skin with adhesive plaster. Care should be taken that this adhesive

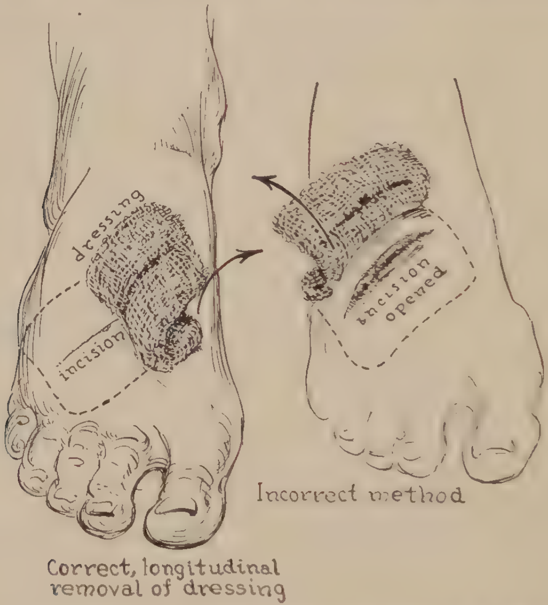

Fig. 9.—The adherent wound dressing should be removed in the direction of the wound axis. By incorrectly removing across an unsutured wound the latter may be torn open.

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[1] De Motte, R. J.: Jour. Indust. Hygiene, 8, 89, March, 1926.

[2] Chambers, H. L.: Jour. Kansas Med. Soc., 26, 383, December, 1926.

plaster is not placed in the hair unless absolutely necessary. For wounds of the scalp a head bandage is preferable to adhesive plaster. A proprietary preparation called "Band-aid" is extremely meritorious. It consists of small strips of adhesive with small sterile pads of gauze already applied to them, and it is an extremely quick and convenient dressing.

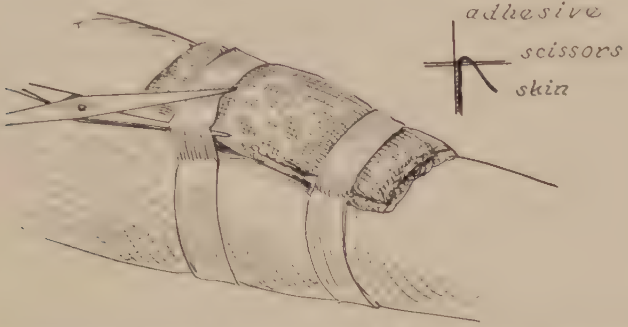

Fig. 10.—Removal of dressing without pulling off the adhesive. Care must be taken that the skin is not pulled up with the adhesive, in which event it may be clipped by the scissors (see insert).

Where a wound has to be repeatedly dressed, it is greatly to the patient's comfort not to remove the adhesive plaster at each dressing, but to cut through it at the junction of the gauze with the place where the adhesive is attached to the skin. In cutting the adhesive at this point extreme care must be taken not to snip the skin itself, which is lifted up as traction is made upon the adhesive (Fig. 10). Kelly[1] has described an ingenious method of fastening hooks (of the "hook-and-

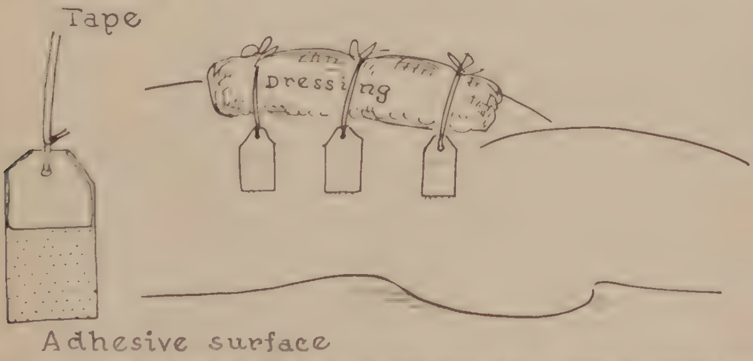

Fig. 11.—Fasteners of adhesive and tape for large wounds which require frequent changes of dressings.

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[1] Kelly, R. E.: Brit. Med. Jour., 1, 462, March 12, 1927.

eye" variety) to adhesive for lacing over wounds. Rubber bands may be used for the lacers. Adhesive strips with taped ends are useful (Fig. 11).

An excellent method of applying gauze to small scalp wounds is by the use of liquid adhesive. The liquid adhesive is applied in a ring around the wound with a cotton applicator and the gauze pressed upon this ring. It will adhere firmly. Similarly, collodion may be used at the margin of the gauze pad to glue it to the skin surfaces.

9. *Rest.*—Wounds will heal more rapidly if they are put at rest. A wound of a finger which is subjected to constant motion should be held quiet with a small tongue depressor splint. Wounds of the skin in the neighborhood of joints are best treated by some method of immobilization of the joint. It is generally unnecessary to splint to the extremity for a wound of this type, but it is extremely valuable to have the patient in bed for several days. For extensive wounds of the arm and wrist the use of a sling is indicated.

INFECTED WOUNDS

1. **Rabies.**—All dog bites should be considered as potentially possible of causing rabies. Even if the tooth of the dog does not penetrate the skin, but merely abrades it, it should be regarded with suspicion. The proper first-aid treatment in cases of this type is to thoroughly cauterize all parts of the wound, including pockets and recesses, with "fuming" nitric acid and to apply a sterile dressing. Punctured wounds should be opened up widely to permit proper cauterization. According to Rosenau,[1] silver nitrate, pure carbolic acid, corrosive sublimate, strong formaldehyde solution, permanganate of potash, and even the actual cautery are not as effective as strong nitric acid. Dog bites of the face particularly should be cauterized, as there infection is more liable because the offending teeth are not wiped off by the clothing before the skin is broken. The period of incubation varies from fourteen days to a year or more. The average period is as follows (Rosenau): Man, forty days (apt to be shorter in children or following bites on the face); dogs, twenty-one to forty days; horses, twenty-eight to fifty-six days; cows, twenty-eight to fifty-six days; pigs, fourteen to twenty-one days; goats and sheep, twenty-one to twenty-eight days; birds, fourteen to forty days. Squirrels are said to be subject to rabies. As it requires fifteen days to produce an active immunity to the disease by the Pasteur preventative treatment, treatment should be instituted promptly. At the Pasteur Institute of Southern India, Coonoor, Madras, 28,898

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[1] Rosenau, M. J.: New England Jour. of Med., 198, 787, May 31, 1928.

persons received the vaccine treatment for rabies in sixteen years, with a total mortality of 1.11 per cent. and a percentage of failures of 0.7.

More important, perhaps, than the first-aid treatment of the wound itself are the complete instructions which should be given to the patient as to the method of inspection of the suspected animal. Where possible the name of the owner of the animal should be at once reported to the Health Officer and Police Department, who will compel the owner of the dog to keep him under observation for a period of two weeks and, if necessary, have him examined by veterinarians. If at the end of this time the dog is free from rabies, infection of the wound may be forgotten. If, however, the dog develops rabies, either as shown by the clinical course of his disease or by the identification of the Negri bodies in the brain of the dead animal, antirabic treatment should at once be instituted.

Rosenau says that "persons who apply for treatment of dog-bite fall into one of the seven following categories with reference to the Pasteur prophylactic or one of its modifications, such as the Semple method.

"1. The dog is mad: In this case, begin treatment at once.

"2. The dog shows suggestive symptoms: Give the treatment at once. In communities having skilled laboratory facilities wait for diagnosis, provided that this is done promptly.

"3. The dog is not mad: Observe it carefully for ten days, and if no symptoms develop there is no danger of rabies in the person bitten. The treatment is, therefore, unnecessary. (The dog may nevertheless develop rabies after ten days, and if it has been bitten by another dog should be kept in quarantine for six months.)

"4. The dog is not identified: This is a common occurrence, especially with children. The rule in such cases is to advise the prophylactic treatment except in regions known to be free of rabies.

"5. Exposure to saliva: Persons not infrequently apply for advice, giving the following history: They have not been bitten, but they have been licked on the hands and face by a dog that subsequently was discovered to have the disease. Persons are sometimes similarly exposed by washing the mouth of a rabid horse. In these cases the important question is whether there were fissures or abrasions in the skin at the time. There may be little wounds in the skin not evident to the eye. It is possible to infect animals by rubbing the virus on the shaved skin. The rule is, therefore, to advise the protection which the treatment affords to persons thus exposed.

"6. In psychoneurotic patients with a distressing phobia of rabies it may afford comfort to give a mild course of treatment as much for its psychotherapeutic effect as for specific immunity.

"7. Fomites: The question is often asked whether the disease may not be contracted from contact with the virus in saliva upon floors, on playthings, and other objects. The situation arises with a rabid dog in the house, where children may be exposed in this indirect manner. While theoretically possible, the danger is small; in fact, I have never heard of a case contracted in any such way. The virus is not infective by mouth."

The antirabic treatment is conveniently done by using the commercial preparations of antirabic vaccine, which consist of a fifteen-dose series, a dose being given daily for fifteen days. The injections which are given subcutaneously are somewhat painful and it is wise to rotate the sites of injection. The subcutaneous tissues of the abdomen, the upper part of the buttock, the subscapular region, the arms and thighs are the places generally used.

2. **Tetanus.**—In certain types of wounds it requires no judgment whatsoever to decide upon the administration of tetanus antitoxin. The sole of the punctured shoe is always a potential source of tetanus infection. The punctured wound of the foot caused by a rusty nail in the garden or the prong of a rake furnish the etiological basis par excellence for tetanus. Of course, no one fears the rust which is merely oxidized iron on the nail, but the presence of rust generally indicates that the nail or other instrument has been lying about outdoors and may have been in contact with the soil. A nail which has been withdrawn from a partition which has lain exposed to the sun or open air, as on a roof or in a lumber pile, is extremely unlikely to cause tetanus infection. In wounds caused by bathers stepping on pieces of glass in the water or on the beach tetanus may develop. Many surgeons are extremely hesitant in the administration of tetanus antitoxin because of the likelihood of anaphylactic reactions, and place their main line of treatment upon very thorough incision and carbolization of the wound. Lecène[1] considers early excision of the wound of inoculation to be of prime importance.

An unusual source of tetanus was reported by Urech.[2] Two months after a cast had been applied to a young man for ankylosis of the knee the patient was readmitted with tetanus. An abrasive wound was found over the inner condyle of the femur. From the straw packing which had been used between the cast and the skin, cultures were made which

[1] Lecène, P.: Bull. et mem. Soc. nat. de chir., 1928, 54, 674.

[2] Urech, E.: Rev. Med. Suisse Rom., September 25, 1926.

caused the death of guinea-pigs from tetanus in three days. The patient recovered after the administration of tetanus antitoxin.

In the borderline cases it is extremely difficult to make a decision, and the patient or the parents of the patient should be acquainted, as nearly as it is possible to do so, with the probabilities and the dangers, and should be invited to share some of the responsibilities in making the decision. Once it is decided to give tetanus antitoxin, the patient should most carefully be interrogated as to the possibility of his having a horse serum sensitization. He should be asked, "Have you ever had diphtheria?" "Have you ever been given antitetanic serum?" "Have you been given any serum?" "Do you suffer from asthma?" "Are you adversely susceptible to horses?" In the event that the patient is likely to be sensitive to horse serum and antitetanic serum is urgently indicated, one must proceed with extreme caution. It is well to dilute the antitetanic serum, 1 : 200, and inject a drop or 2 drops *in* the skin. If no severe reaction ensues, one may cautiously proceed with the balance of the injection. The danger of tetanus infection is ever present and cannot be too seriously considered. Tetanus infection has occurred following an abraded wound of the forehead caused by a fall in the street in a case where the wound had been treated by the ill-advised application of collodion.

All bullet wounds should receive tetanus antitoxin barring definite clinical indications.

The treatment of a case of tetanus does not belong to the realm of minor surgery.[1]

3. **Diphtheria.**—Occasionally the Klebs-Löffler bacillus may be found in wounds and identified by smear or culture. The treatment calls for the administration of diphtheria antitoxin.

4. **Scarlet fever** may occur in wounds (traumatic scarlatina). The eruption takes place at the wound and from there spreads over the body. Scarlet fever of this type has a less severe course than ordinary scarlet fever.[2]

5. **Erysipelas** is a cutaneous infection caused by the hemolytic streptococcus and invariably originates in a wound. The wound may be so minute, however, as not to be visible. Erysipelas originating from lacerated wounds occurs much less frequently than formerly owing to improvements in first-aid treatment and proper technic in dressings.

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[1] References: Wainwright, J. M., Tetanus: Its Incidence and Treatment, Arch. Surg., 12, 1062, 1926; Ashhurst, A. P. C., The Prognosis of Tetanus, Jour. Amer. Med. Assoc., 1926, 87, 2089.

[2] Anders and Musser: Practice of Medicine, W. B. Saunders Co., 1920.

It generally occurs on the face and is ushered in by a chill and fever, and while most commonly running its course in from four to eight days, may last for weeks. The mortality in hospitals according to Tileston is from 4 to 9 per cent. The customary treatment of erysipelas is the use of cold compresses either of boric solution or very dilute alcohol. Twenty-five per cent. ichthyol ointment has been employed with what are considered successful results. The contractile collodion recommended by Woodyatt as a barrier to the advancing infection occasionally has been helpful. The copious administration of fluid is essential. According to Birkhaug[1] good results have been obtained in 60 cases with the use of antistreptococcic serum. McCann[2] is unconvinced of any definite value of erysipelas serum. A clinical study of the treatment of erysipelas was recently made by Platou, Schlutz, and Collins.[3] Of 155 cases, 35 were treated by local application, 80 by Roentgen-ray irradiation, 30 with erysipelas antitoxin, and 10 with Roentgen ray and antitoxin combined. The return to normal temperature, the disappearance of the symptoms of pain and general malaise was more rapid, the extension of the disease occurred less frequently, and the mortality was one-fourth in the group treated by Roentgen ray as compared with the group treated by local applications. These writers also found the antitoxin to be of definite value. They conclude that "probably the best form of treatment available at the present time includes the intravenous, intraperitoneal, or intramuscular administration of erysipelas antitoxin in adequate dosage, in addition to a proper (large) Roentgen-ray irradiation of the involved area and the contiguous normal skin."

6. **Anthrax** (malignant pustule) is an infection caused by the bacillus anthracis, and in addition to the cutaneous form there may also occur pulmonary and intestinal types. Anthrax is commonly seen on the neck, face, hands, arms, and shoulders of individuals who work among hides or sheep skins. Several years ago a number of cases of the disease occurred in this country through the use of infected Japanese shaving brushes. In the cutaneous type the initial lesion is often similar to an incipient furuncle. In many cases it has unfortunately been mistaken for such and incised.

Anthrax begins as an inflammatory papule accompanied by considerable itching, and then rapidly develops into a pustule on an angry inflammatory base. Induration and inflammatory edema surrounding the lesion are so extensive and the constitutional symptoms so severe that one realizes that he is dealing with a more serious disturbance than an ordinary pyogenic infection. The pustule rapidly ruptures, leaving a brown or black gangrenous slough in its wake (Fig. 12). There may be and often are a number of vesicles or pustules surrounding this eschar. The neighboring lymph-nodes are inflamed and swollen; septicemia rapidly ensues, and unless proper treatment is immediately instituted, death ensues within a few days. In this stage the diagnosis can easily be made by examination of direct smears and by cultures. Whereas formerly the accepted treatment was excision of the pustule, today surgical intervention is contraindicated. According to Symmers[1] and other authorities, there should be no local treatment but the administration of anti-anthrax serum. The results following the administration of the serum have been highly successful.

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[1] Birkhaug, K. E.: Johns Hopkins Hospital Bulletin, 37, 307, 1925.

[2] McCann, W. S.: Jour. Amer. Med. Assoc., 1928, 91, 78.

[3] Platou, E. S., Schlutz, F. W., and Collins, L.: Amer. Jour. Dis. Child., 34, 1030, December, 1927.

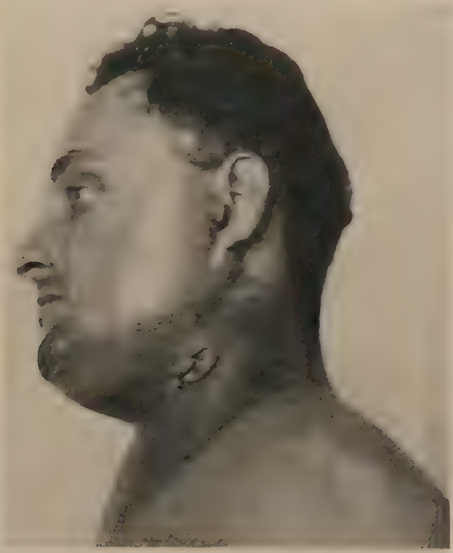

Fig. 12.—Anthrax. (Courtesy of Dr. Edward A. Oliver.)

7. **Actinomycosis** is caused by streptothrix actinomyces of ray-fungus, a vegetable fungus. This organism is generally encountered as a saprophyte on hay, wheat, oats, and barley. In many of the human cases a direct history of chewing grass or straw can be obtained from the patient. The commonest locations of the affection are the tissues about the face and neck, though abdominal and pulmonary infections are

[1] Symmers, D.: Ann. Surg., 75, 663, June, 1922 (Cecil, 225).

seen (Fig. 13). Infection commonly occurs through the mouth, chiefly through decayed teeth. The incubation period of the disease is variable. Sometimes several months may intervene before the development of the subcutaneous nodules or groups of nodules. Its typical development is seen best in the cervical type of the disease, where about the jaw and in the submaxillary region nodules varying in size from a hickory nut to a walnut develop. They rapidly increase in number, coalesce, and form dark red patches and infiltrations, beset with numerous sinuses and areas of bleeding granulation tissue. These lesions are generally painless. Constitutional symptoms are very rarely noted unless the disease is complicated by the involvement of deeper structures or through the development of septicemia.

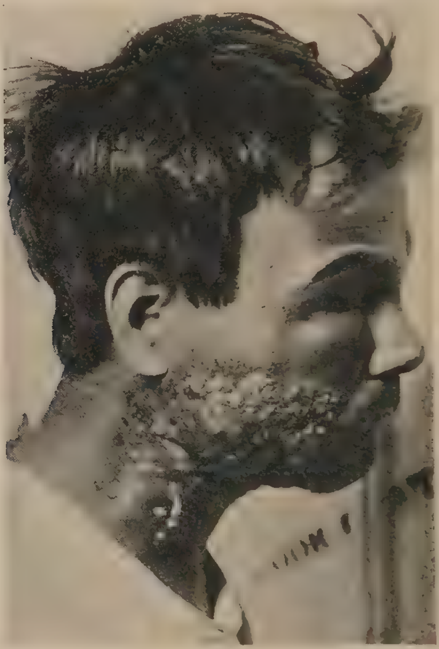

Fig. 13.—Actinomycosis. (Courtesy of Dr. Edward A. Oliver.)

Surgical measures are of great value in the early stage. If practical, complete excision of the involved area should be done. If the patient is not seen until there is extensive tumor development, surgery should consist of the free opening and curetment of the fistulous tracts. The iodides, chiefly potassium iodide and tincture of iodine, are of great value in causing involution of the nodules and should be given in every case. In many cases x-ray therapy will prove of distinct service. The average well-developed case will tax skill and resourcefulness of the medical attendant.

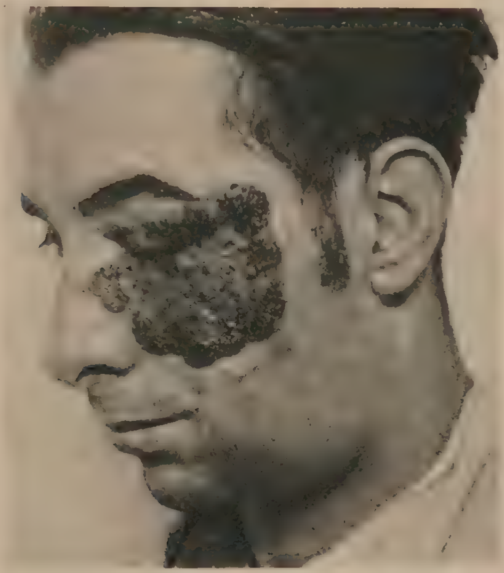

Fig. 14.—Blastomycosis of face. (Courtesy of Dr. Edward A. Oliver.)

The diagnosis is made by the finding of pin-head sized, sulphur-yellow granules in the pus and the discovery of the organism (the ray-fungus).

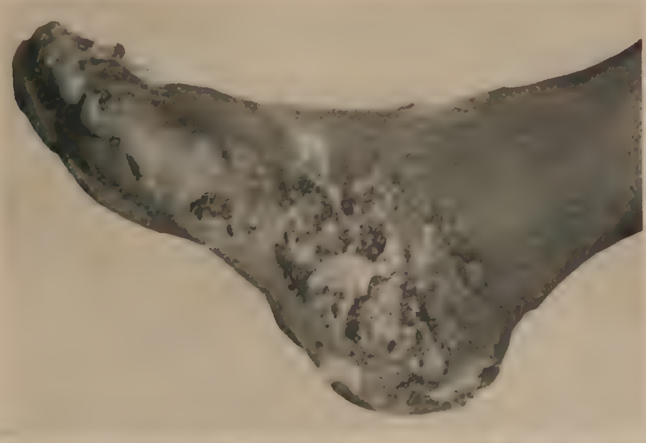

Fig. 15.—Blastomycosis of foot. (Courtesy of Dr. John A. Wolfer, Surgical Dispensary, Northwestern University Medical School.)

8. **Blastomycosis** is a chronic infectious disease caused by a yeast fungus. It may either affect the skin alone or be a systemic infection.

Dermatologic cases are far more common than are those of the systemic variety. The disease is uncommon in America except in the vicinity of Chicago, where many cases are encountered (Figs. 14, 15).

Blastomycosis of the skin begins as a small pea-sized papule or papulopustule. The lesion spreads peripherally and grows rather rapidly. In any one case one may see some small pea-sized lesions or several larger patches. Whatever the size, the characteristics of the lesion are the same. It is practically painless, its top generally rough with warty, papillomatous vegetations, its base soft, and pressure of the lesion causes droplets of pus to exude from between the surface papillæ. The lesion is definitely raised from $\frac{1}{4}$ to $\frac{3}{8}$ inch above the surrounding skin and it has a sloping inflammatory border in which are seen, generally with the aid of a hand glass, minute pin-point to pin-head-sized abscesses. In these abscesses the organism is readily found.

The pus is best examined by spreading a little on a glass slide, moistening it with 15 per cent. potassium hydroxide solution, and then examining it under the high dry power of the microscope.

The disease may occur anywhere on the body, but most commonly affects the skin of the face and hands. The region about the lower eyelids we see very commonly affected.

One so often sees lesions in diverse portions of the body that there is no doubt that the condition is spread by auto-inoculation.

Systemic blastomycosis while not nearly so common as blastomycetic dermatitis, does occur. Almost any organ in the body may be affected, but the disease most commonly attacks the lungs. It very seldom follows the cutaneous type. Most cases occur without any preceding dermatologic manifestations. This type of the disease is often mistaken for tuberculosis, and a definite diagnosis can only be made by finding the organism.

The *prognosis* in both types is serious. Nearly all of them die in the systemic type, even in the cutaneous type. Recurrences are common and the disease often taxes all the resources one has.

The *treatment* is principally medicinal. Potassium iodide in large doses should always be given. Neo-arsphenamine is also of value, as is x-ray and radiotherapy, and occasionally surgery. Jackson[1] treated 2 cases of extensive blastomycotic skin lesions by thoroughly cooking the area to a depth of 3 or 4 cm. by means of large soldering irons heated to a dull red. The cooked surface was then curetted until blood appeared, when the irons were again applied. This procedure was repeated until all evidence of the disease has been removed. At the conclusion of the operation a hot wet dressing of 1 per cent. copper sulphate solution was applied. Balsam of Peru is useful for the granulating area. Hedge[1] has successfully treated 2 cases of blastomycosis with carbon dioxide snow. Locally the best application to use is one of a 1 per cent. copper sulphate solution.

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[1] Jackson, R. H.: Amer. Jour. Surg., 1926, n. s., 1, 185.

9. **Sporotrichosis** is a granulomatous disease involving the skin and subcutaneous tissues caused by the Sporothrix schencki.

The disease, while not common, is not considered a rarity. The organism responsible for the disease most often gains entrance through a wound of the finger or hand. After several weeks this wound is followed by the development of a chain of subcutaneous nodules up the lymphatics of the arm. These nodules vary in size from a split pea to that of a cherry, develop slowly, and may break down, forming sporotrichial gummas. They give rise to very little pain and respond readily to treatment. If gummas have resulted from the breaking down of the nodules healing occurs, with rather marked scar formation.

Occasionally bones have been involved. The disease very markedly resembles tuberculosis and tularemia and only by cultural methods can an exact diagnosis be made.

Treatment.—The disease readily responds to treatment with fairly large doses of potassium iodide.

10. **Tularemia** is a disease caused by the Bacterium tularense. The disease is not contagious from man to man, but is carried by the wood tick, deer fly, and the wild cotton-tail rabbit. According to Simpson,[2] "the greatest number of cases have occurred among market men who have skinned or dressed rabbits; in housewives or servants who have dressed rabbits for the table; in hunters who have dressed rabbits during the hunt; in farmers or ranchers who have picked infected flies or ticks from their horses or cattle, or who have cut up jack-rabbits for fish bait, coyote bait, or for food for domestic animals." There are four clinical types of the disease: (*a*) The ulceroglandular type which comprises two-thirds of the cases. In this there is a papule at the point of inoculation, usually the finger or hand. The papule becomes painful and swollen and suppurates, liberating a necrotic core and leaving an ulcer (Simpson). The regional lymph-glands become hard and may suppurate. The patient has severe "grippe-like" symptoms and may become delirious. (*b*) The oculoglandular type, with the primary localization in the conjunctiva. (*c*) The glandular type with no visible

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[1] Hedge, Harry M.: Jour. Amer. Med. Assoc., 90, 1367, April 28, 1928.

[2] Simpson, W. M.: International Surgical Digest, 6, 131, September, 1928.

primary lesion. (*d*) The typhoid type in which the outstanding symptom is fever.

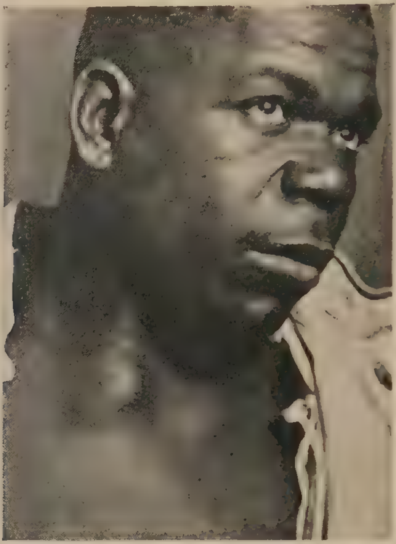

Fig. 16.—Gumma. (Courtesy of Dr. Edward A. Oliver.)

The diagnosis is made by the history and the highly specific Bacterium tularense agglutination reaction. No specific treatment has been discovered. According to Simpson (*loc. cit*) "it is useless to incise the primary lesion, and it is unwise to excise, or even incise, the enlarged

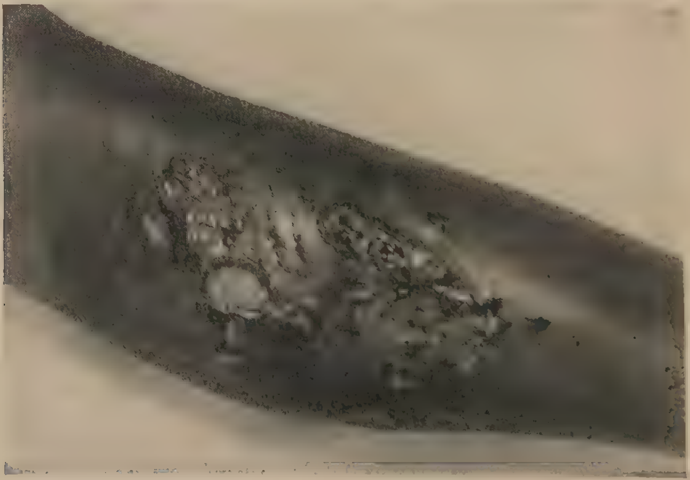

Fig. 17.—Tertiary syphilis. Multiple gummata of the leg. (Courtesy of Dr. Edward A. Oliver.)

regional lymph-nodes until definite suppuration is present. The prophylactic treatment is important."

11. **Tuberculosis Verrucosa Cutis.**—While this may occur any place on the skin, its commonest locations are on the backs of the hands and fingers. It is always due to inoculation with the tubercle bacillus and is frequently seen in meat handlers or in pathologists. One type of lesion is called the "*anatomical tubercle*" or "*postmortem wart.*" This is situated on the fingers or hands and is often the size of a dime. Larger patches may also occur. The patch is generally elevated, infiltrated, wart-like, dark red or purplish in color, and resembles to some degree the lesion of blastomycosis. It is generally dry, productive of no sensation, grows very slowly, lasting for years, and occasionally disappears spontaneously. The small lesions may be excised; the larger ones are best treated by the use of 10 per cent. salicylic acid ointment or by exposures to the x-ray.

12. **Syphilitic gummata** may occur anywhere on the skin. Their common sites, however, are on the legs, forehead, and sternal region. Gummata as seen on the legs are generally on the upper and posterior aspect. They usually are single, but may be multiple (Fig. 16). They begin deep in the tissues as pea- to nut-sized nodules, generally increase in size, and as they approach the surface the skin over it becomes a dark red or purplish color. The overlying skin softens, gives away, and a clean-cut, punched-out ulcer is the result (Fig. 17). Secondary infection rarely occurs. Surgical treatment is distinctly contraindicated; the lesions heal promptly under antiluetic therapy.

NON-SPECIFIC INFECTED WOUNDS

These wounds are caused by the ordinary pyogenic organisms, the staphylococcus and streptococcus predominating. Their presence in the wound may be found very early, in from two to eight hours, after contamination.

Woolsey[1] has likened an infected wound to a battlefield. The invading forces, or infections, are the staphylococcus, streptococcus, colon bacillus, proteolytic and anaërobic organisms. The defending forces are the local and the general resistance. The former consists of incision, drainage, removal of devitalized tissue, antiseptics, immobilization, elevation of the injured member, and heat. The latter consists of rest, fluids, food, serums, vaccines, 6 to 10 per cent. glucose solutions, saline (intravenously or by hypodermoclysis), blood transfusions, and anodynes.

[1] Woolsey, J. H.: Surgical Clinics of North America, 6, 557, April, 1926.

(*a*) **Symptoms.**—The symptoms of pyogenic infection in closed or sutured wounds consist of increasing pain, which is of a throbbing character and synchronous with the pulse beat, swelling, and redness about the wound margin. The temperature may be elevated and a leukocytosis is not uncommon. In open wounds the signs and symptoms of infection are, first and foremost, a purulent discharge. There may also be the other signs which are found in closed wounds, such as pain, redness, and swelling.

(*b*) **Treatment.**—Sutured or healed wounds which show signs of infection require prompt treatment. The wound should first be reopened by probe, scissors, or divulsing hemostat at the point of maximum inflammation. The opening should be continued until the extent of the infected area has been exposed. The pus, if present, will then be evacuated and the abscess cavity, if present, may be irrigated with a warm boric or dilute iodine solution. A drain should then be inserted which is made either of rubber, Penrose tubing, or gauze, and, if necessary, the wound edges should be loosely packed to prevent the premature approximation of the skin edges. Warm boric fomentations should then be applied, and after this the physician should proceed as in the case of infected open wounds to be described below.

The *technic of hot boric fomentations* is one that is rarely accurately accomplished and one that requires a certain amount of skill on the part of the attendant or on the part of the patient if he cannot be provided with a nurse. If the skin be extremely tender in the neighborhood of the wound it is occasionally of value to anoint it with a thin layer of sterile vaseline. After this gauze, which has been wrung out in warm, *not hot*, saturated boric acid solution, should be copiously applied to the wound. The common error is not to apply sufficient gauze or absorbing material. The infected area should be enveloped for at least 5 or 6 inches beyond its margin with a thickness of overlying gauze of at least 1 inch and, preferably, 2 inches. This large bulk of dressing insures the maintenance of a continuous hypertonic pack. The action of saturated boric solution is but mildly hypertonic, and where a more powerful action is desired, magnesium sulphate or aluminum acetate (caution!) are to be recommended. After the gauze has been bandaged neatly in place a rubber sheet, oiled silk, or other impervious material is placed over the moist dressings. An electric pad (or pads) is then applied to this waterproof surface. The patient is cautioned not to allow the electric pad to become wet because of the risk of short-circuiting the pad. Over the top of the electric pad is now placed a binder or bath towel which is snugly pinned so as to hold the electric pad in position (Fig. 18). The pad is then connected with the light socket and turned on at low or medium heat, as suits the patient. In ambulatory cases, such as carbuncles of the neck, the patient may walk about the house and "plug in" where most convenient for him (Fig. 19). From time to time as the solution becomes evaporated because of the heat of the pad, it should be replenished by cautiously opening up one end of the dressing and pouring in from a sterile receptacle the solution in question. By this method patients may with comfort sleep through the night, and a continuous, moist, hot, hypertonic treatment be carried out without interruption.

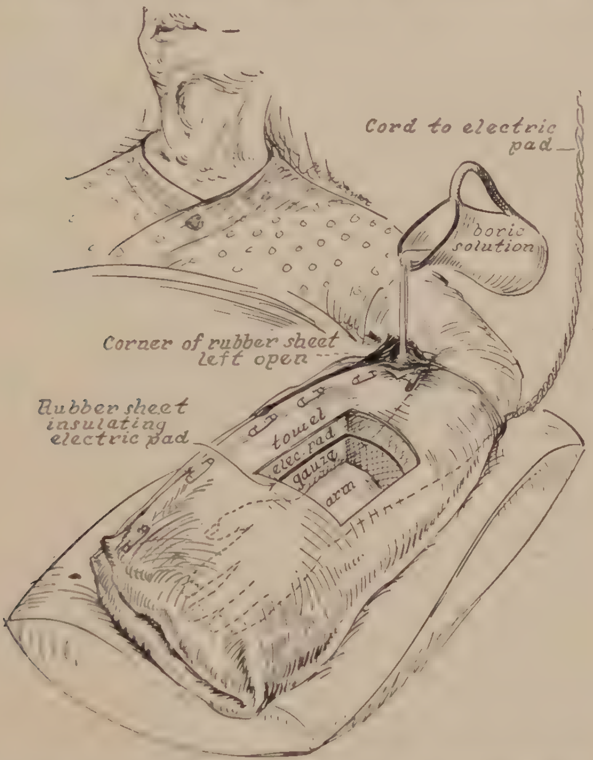
Cord to electric pad
boric solution
Corner of rubber sheet left open
Rubber sheet insulating electric pad
towel
elec. pad
gauze
arm

Fig. 18.—The technic of hot boric fomentations. An abundant quantity of gauze moistened with boric solution is placed over and well beyond the infected area. The gauze is entirely covered by a layer of rubber sheeting or other waterproof material. The waterproof material will insulate the electric pad, which comes next, and outside of all a towel is pinned to hold the pad in place. As the boric solution evaporates from the gauze more is added at a corner. In the absence of an electric pad a hot-water bottle or frequent changes of hot gauze will be necessary.

The care of open wounds is based chiefly upon the principles of cleanliness, wound antisepsis, and adequate absorption of wound secretions. In the case of animals who continually lick their open wounds the first two principles are not active, but the efficient removal of the wound secretion by the tongue of the animal brings about a clean, granulating wound which generally heals without complication.

The skin in the neighborhood of the infected wound must be scrupulously clean; if hair be present it must be shaven away. The skin must be cleansed with soap, preferably green soap and water. After this it should be treated to an antiseptic wash, preferably with alcohol or ether. It is not uncommon, in the case of infected wounds where these precautions are omitted, to have the development of numerous furuncles or spreading pyodermia. Webb[1] believes that furunculosis about a wound may be diminished by daily exposures to the ultraviolet ray and to mild doses of *x*-ray. Vigorous instrumentation by mechanical cleansing of the wound should be avoided. Irrigations with mild antiseptic solution under low pressure occasionally are justified. Where the wound has any depth or where there is a tendency for too rapid closure of the skin edges, rubber drainage or a loose gauze packing should be inserted. The application or instillation of an antiseptic into the depths of the wound is of considerable value in the destruction of

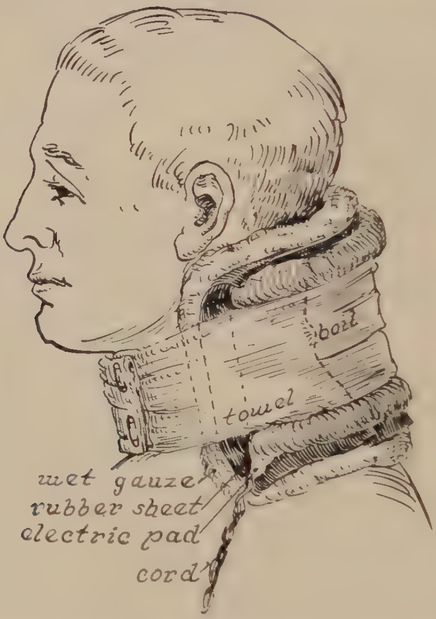

Fig. 19.—Technic of continuous hot boric fomentations to the neck with employment of the electric pad.

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[1] Webb, R. C.: Personal communication.

the surface bacteria. For this purpose mercurochrome, 2 per cent., and metaphen, 1 : 2000 solution, deserve first choice; 0.1 per cent. trypaflavin has many advocates. In very large wounds the Carrel-Dakin treatment should be instituted (see below). In deep wounds where the purulent discharge has subsided and clean granulations are beginning to form the healing may be accelerated by the use of balsam of Peru or iodoform packing. Packing should never be tightly inserted in any wound.

A physician's acquaintance with the art of surgery may rather accurately be estimated by the manner in which he changes his dressing. Any one who grasps in his fingers pus-soaked dressings may be stamped as a man who is grossly inefficient. He endangers himself and the patients entrusted to his care. All infected purulent dressings should be removed with sterile instruments and should be placed in a paper bag or suitable receptacle. The dressing may be adherent to the wound. This annoyance may be greatly mitigated by the previous application to the wound edges of either sterile white vaseline, boric ointment, or mercurochrome. It is extremely important where the dressing is adherent to remove it in such a manner that the traction is parallel to and not across the wound edges. All manipulations about the wound, as cleansing of the skin, irrigations, and applications of antiseptics, should be done with instruments. In the ideal dressing the surgeon's hands never come in contact with the wound or the dressing.

Carrel-Dakin Technic.—In civil practice the Carrel-Dakin technic is used far less frequently than it should be. This is due, no doubt, either to the unacquaintance of the physicians with this method or to the extreme amount of attention to detail which it requires. In large infected wounds, however, the Carrel-Dakin treatment has no superior. The skin in the neighborhood of the wound is first cleansed with a neutral soap solution and dried with sterile gauze. Sheets of vaseline gauze are then applied about the wound edges. This vaseline gauze is often made containing a small amount of rosin to make it more adherent. It should be applied in layers of one thickness only and should be devoid of wrinkles. All parts of the skin up to the edges of the wound should be carefully covered. The purpose of the vaseline gauze is to protect the skin from the irritating action of the Dakin solution (Fig. 20). The Dakin solution, which is 0.45 to 0.5 per cent. solution of hypochlorite of soda and which requires considerable skill in its preparation, is administered to the depths of the wound by the Carrel tubes. These are small rubber tubes which are tied off at the distal end and which contain a varying number of small perforations, according to the shape and size of the wound. The tube is loosely wrapped in gauze which has been moistened with Dakin's solution and placed in the wound. Further pieces of gauze, likewise moist, are loosely packed in on top of this so

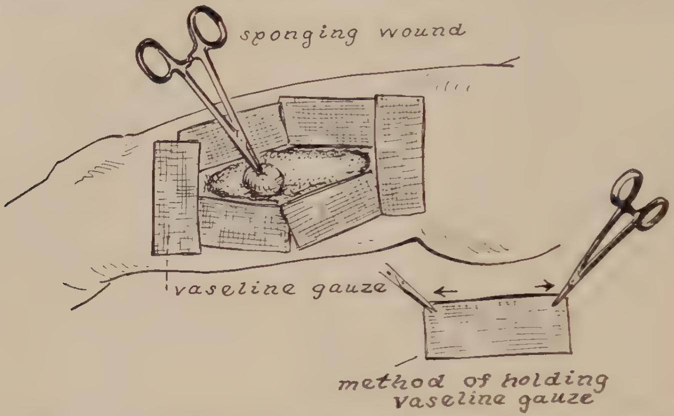
sponging wound
vaseline gauze
method of holding vaseline gauze

Fig. 20.—Carrel-Dakin treatment. The skin in the neighborhood of the wound is protected by pieces of vaseline gauze.

that the tube or tubes are held in position (Fig. 21). The tube or tubes are then so arranged that at regular intervals, generally two hours, a given quantity of Dakin's solution, generally 10 c.c., is instilled with

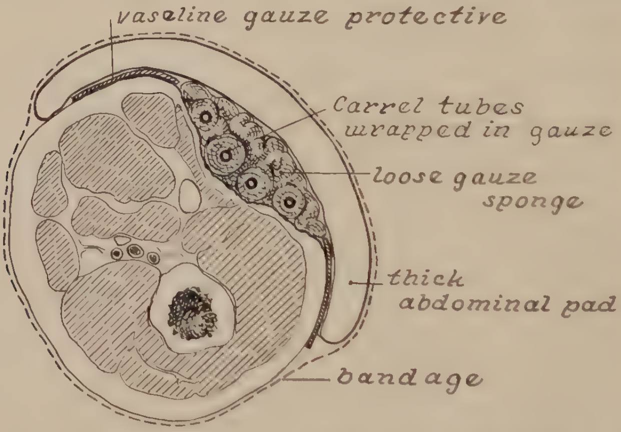
vaseline gauze protective
Carrel tubes wrapped in gauze
loose gauze sponge
thick abdominal pad
bandage

Fig. 21.—Carrel-Dakin treatment. Cross-section of an extremity showing the details of the dressing. The Carrel tubes are wrapped in gauze and held in the wound by loose gauze packing.

a hand syringe (Fig. 22). The dressings are changed every twenty-four hours and the depths of the wound are gently cleansed with neutral soap, and freshly sterile tubes are put in place. An essential part of this treatment is the periodical examination of smears made from the wound surface. When the wound has become consistently free of bacteria, operative closure is to be considered.

For further details of the Carrel-Dakin treatment the reader is referred to Carrel and Dehelly's "Infected Wounds."[1]

In broad shallow wounds, such as varicose ulcers, various ointments are of benefit. Included in these are the scarlet-red ointment and the Credé or metallic silver ointment.

Infected wounds must be put at rest. An infected wound of the skin over an interphalangeal articulation of a finger should be splinted with a small tongue depressor splint. Likewise, infections of the extremities require splintage and elevation.

Where the purulent discharge has reached the minimum and the wound secretion has a glairy mucoid type, it is generally wise to begin measures to approximate the wound edges. This is most conveniently done by using strips of adhesive plaster which are not placed too closely together, so as to bar the exit of wound secretion.

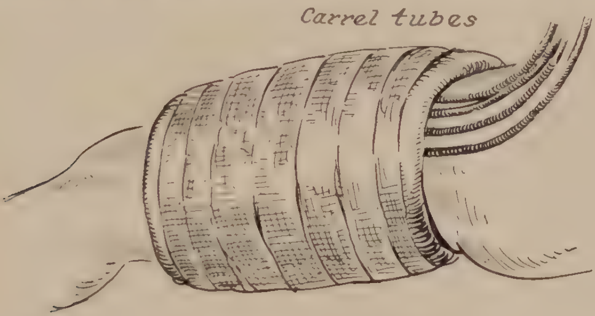

Fig. 22.—Carrel-Dakin treatment. Large gauze pad is loosely bandaged in place. The Carrel tubes are shown emerging from beneath the dressing.

Occasionally infected wounds may be accompanied by such complete disorganization of the soft parts that amputation becomes necessary. Amputation, however, should only be considered as a life-saving measure when it is evident that the extremity may not be saved.

Patients with infected wounds should be made as comfortable as possible. Where the pain is severe, capsules consisting of aspirin, 5 grains, and codein, ½ grain, are very efficient and may be given as often as every four hours. Fluids should be pushed and laxatives given to insure proper elimination.

Orator[2] believes that the healing of infected wounds is accelerated by the daily administration of 3 to 10 grams of ammonium chloride to acidify the patient. The hypodermic administration of casein may be of value.

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[1] Carrel, A., and Dehelly, G.: Infected Wounds, Paul B. Hoeber, New York.

[2] Orator, V.: Wien. klin. Wchnschr., 40, 293, March 3, 1927.

Erythema nodosum is an acute cutaneous disease characterized by the appearance of pinkish-red tender nodules generally seen on the anterior tibial surfaces. The lesions are generally multiple, symmetrically distributed on both lower limbs, and simulate, to some extent, a bruise. They begin deep down in the tissues as pea-sized nodules which gradually increase in size; become more inflammatory as they reach the surface, and, while they may fluctuate, they never suppurate. The lesions are thought to be associated with rheumatic diathesis, such as tonsillitis, infected teeth, pains in the bones and joints. With the advent of the eruption the temperature may be slightly elevated, and there may be general malaise and pains in the joints. The eruption is self-limited. Surgical treatment is *not* indicated. Hot boric fomentations, rest in bed, 10 per cent. ichthyol ointment, and the administration of salicylates internally are all that are needed.

Bromide eruptions are often seen on the lower extremities. The lesions induced by the ingestion of large doses of bromides may be those of an acne. Commonly, however, on the lower extremity the eruption takes on the appearance of papillomatous warty lesions, somewhat resembling those of blastomycosis. The lesion is a soft nodule varying in size from a pea to that of a quarter, is verrucous in character, and is covered with a heavy crust. The diagnosis is sometimes difficult and can only be made by the history and by the detection of bromine in the urine. The treatment in cases of this kind consists in keeping the lesion clean and the intravenous administration of normal saline.

CHAPTER III

FOREIGN BODIES

TYPES OF FOREIGN BODIES

A GREAT variety of foreign bodies have been encountered in the human body. A large group includes all types of missiles; bullets, fragments of shrapnel, cartridge wadding, B-B shot are common types (Fig. 23). Another group comprises those foreign bodies which have been left in the body following wounds: Needles, portions of needles, pieces of glass, splinters, etc., are to be included in this group. A very large group of foreign bodies is composed of those which find their entrance into the body through the orifices. The eye, nose, mouth (including bodies in both the esophagus and trachea), urethra, and anus are included in this group.

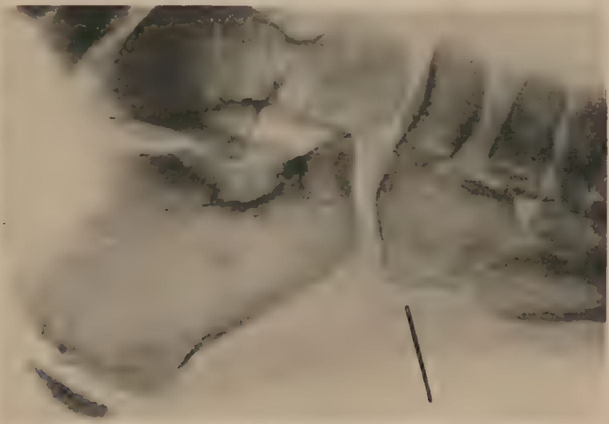

Fig. 23.—Sewing needle embedded in sole of foot.

"Compact and insoluble foreign bodies are shut in by new-formed tissue, which is slowly transformed into a connective-tissue capsule, gradually shutting the foreign body off from contiguity with the organism."[1] Foreign bodies which are not infected may remain in the tissue indefinitely without causing symptoms. Paschal[2] reports the case of an Indian, who for sixty-one years carried an encysted arrowhead in his thorax wall between the second and third ribs. Another case of Paschal's carried an arrowhead for twenty years. The first eight years were symptomless but then the foreign body became infected, and for the remaining twelve years the patient suffered from abscesses and sinuses. In a third case reported by this writer the patient carried a sizable piece of glass in his thigh for eight years without symptoms, until a blow upon the thigh made it painful. Kummer's[1] case is of interest. Kummer removed a cyst the size of a pea formed about a fragment of needle embedded in a finger for three years. The cyst was pear shaped. The stem of the pear was formed by the needle closely surrounded by tissue. The other end projected into the bulbous cavity.

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[1] Martin, W.: Ann. Surg., 63, 24, 1916.

[2] Paschal, F.: Ann. Surg., 79, 114, 1924.

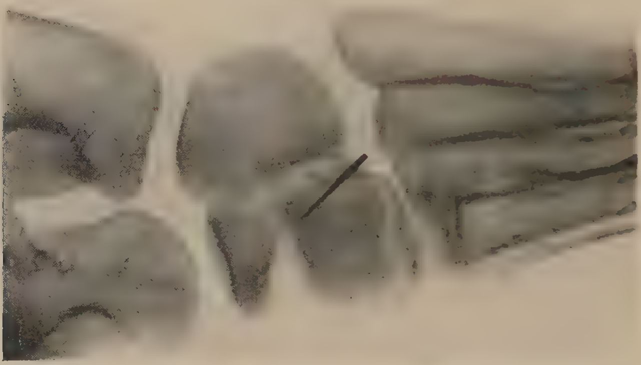

Fig. 24.—Victrola needle in foot.

As far back as 1797 there was described the case in which a thorn was removed from a man's leg after remaining there for twenty-two years.[2] In 1817 Bush[3] reported the case of a sailor, in the muscles of whose back the blade of a knife had lodged for over thirty years. In Evans' case[4] a stone was embedded in the arm for seven years.

Norris and Reich[5] believe that metallic foreign bodies cause very little trouble in the tissues and believe that the indications for their removal are when they produce mechanical irritation or pressure, or when they are located in an infected field. They say, "When foreign bodies cause mechanical irritation in the pleura or are adjacent to nerves, as for instance, the sciatic, resulting in causalgia, or when they are in close approximation to a blood-vessel causing erosion of its wall, it is obvious that removal is necessary. When a piece of shell is free in a joint or projects into it, serious damage results and it must be removed. Removal is also indicated when foreign bodies are located about points of pressure, most commonly the sole of the foot, the palm of the hand,

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[1] Kummer: Rev. de Chir., 1891, N. 7, quoted by Martin.

[2] Fryer, H.: Medical Facts and Observations, London, 7, 89, 1797.

[3] Bush, F.: Med. Chir. Tr. Lond., 2, 103, 1817.

[4] Evans, W. O.: Brit. Med. Jour., London, 1, 1439, 1895.

[5] Norris, F. A., and Reich, R. S.: Surgical Clinics of Chicago, 3, 861, 1919.

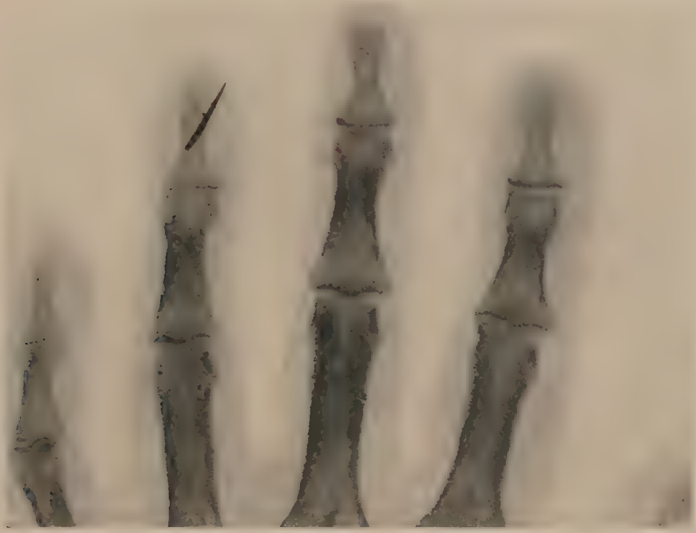

Fig. 25.—Needle in finger-tip. Anteroposterior view.

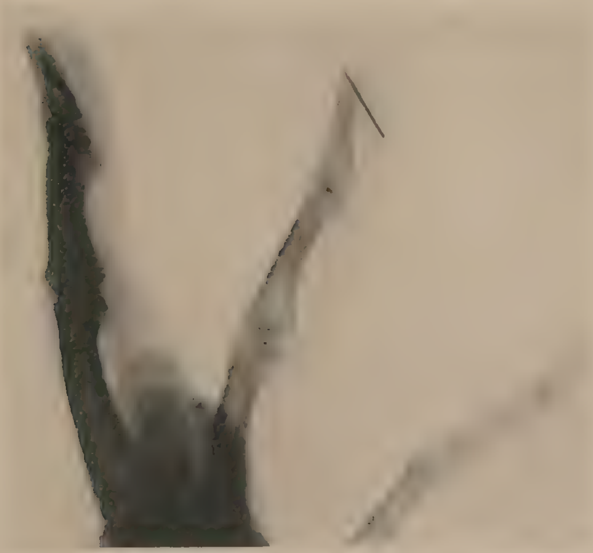

Fig. 26.—Needle in finger-tip (same as Fig. 25). Lateral view.

the back, the buttocks. . . ." The author knows of a case where a steel fragment was embedded in the wall of the brachial artery. Upon its removal a copious hemorrhage ensued until a tourniquet was applied. Foreign bodies in the veins may migrate to the heart or lungs (Warthen[1]).

All types of needles have been found in the body (Figs. 23–27). The common sewing needle, broken off fragments of sewing machine needles and portions of surgical and hypodermic needles, are the commoner types. There is no question that needles and other sharp-pointed or thin foreign bodies will move about in the body. A woman presented herself to the writer at the New York Hospital with a needle in the soft tissues of the neck, which was easily removed under local anesthesia. The chief point of interest in this case was that she had absolutely no recollection of the time when the needle entered the body. Needles have worked their way along muscle planes to sites remote from their point of entry. Numerous instances have been recorded of migration of foreign bodies. In less than three hours a sewing needle had wandered from a wound a hand's breadth above the elbow to the forearm.[2] In 1851 Winzar[3] described a case where "by free use of his common bleeding lancet" he removed from beneath the skin of the lower abdomen a silver teaspoon, three pieces of whalebone, and a piece of red cloth. It is possible that these articles passed through a perforation in the cecum and lay in an abscess cavity. The case of Kircher[4] is of interest in this connection. The patient swallowed a needle in February, 1924, and *x*-ray examination showed it to be in the region of the stomach. Laparotomy at this time, however, disclosed an empty stomach. Two and one-half years later the point of the needle came out through the skin at the border of the sternum at the level of the fourth rib. In Koenig's case[5] a pin became lodged in the upper part of the esophagus. The pin became dislodged, slipped by the epiglottis,

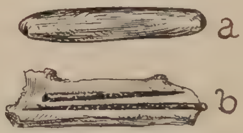

Fig. 27.—Foreign body (needle fragments) embedded in thigh for many years. Note connective-tissue capsule.

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[1] Warthen, H. J., Jr.: Arch. Surg., 1927, 15, 712.

[2] Muskat, G.: Med. Klin., Berlin, 4, 1373, 1908.

[3] Winzar, J.: Lancet, London, 1, 177, 1851.

[4] Kircher: Münch. med. Wchnschr., 73, 2169, December 17, 1926.

[5] Koenig, E. C.: Amer. Jour. Roentgenol., 7, 327, n. s., 1920.

through the larynx, and down the trachea to the right bronchus. Later, the pin was coughed up, reswallowed, was transmitted along the alimentary tract, and finally was expelled from the rectum. Martin[1] cut down upon a needle which had been shown by x-ray the day before to be in the palm of the hand. It was finally found under the annular ligament, 4 inches away.

David[2] reports a case of fish bone accidentally swallowed and said to have been expelled per urethra after two years and five months. Rubesch[3] reports a case of embolism of a bullet from the heart to the right femoral artery. A case has been reported in which a scrap of projectile was found in the right lung which had entered the right thigh six years before.[4]

One of the most extraordinary cases is that of Liebe.[5] A seventeen-year-old girl believed that she had a splinter in her right great toe and tried to pick it out. She succeeded in grasping the object and, on pulling it out, found to her astonishment that it was a horsehair, 8 inches long. She had played about horses as a child and it was thought that she might have swallowed it.

Glass is a very common foreign body following shattering of windshields, broken windows, etc. Porcelain and pottery have been found in wounds of the feet. Rust from iron nails has been left in the tissues after the withdrawal of the nail from punctured wound. Broken off fragments of wood splinters may be found in the skin, under the skin, and under the nails. Vegetable substances, such as beans, which may be found in the orifices, and thorns, which may become embedded in the skin, have been reported. Animal matter such as insects, which may enter the external meatus, or eggs of insects may be found. Certain objects in the lumen of the intestine may become a foreign body by virtue of their inability to pass. In this category may be mentioned hair-balls of the stomach (trichobezoars) which come about from the habit of eating hair and the consequent formation of a large hair-ball which does not pass from the stomach. Murphy buttons which are less in use now than formerly have occasionally acted as foreign bodies and caused intestinal obstruction.

Symptoms of foreign bodies depend upon the time after their entry into the tissues. In fresh wounds the symptoms incident to the wound itself may predominate over that of the foreign body. A bullet buried in the soft parts, if not striking any vital organ or vessel, may cause practically no symptoms and its presence be indicated only by the fact that there is a wound of entrance and not a wound of exit. The bullet itself in many cases may be palpated just under the skin. Its removal under local anesthesia will then be a very simple minor surgical procedure. Many curious wounds have been occasioned by bullets and the indication of the buried bullet may be problematical without the x-ray. Two bullets fired in quick succession have been known to cause but one wound of entrance and two wounds of exit and would give rise to the expectation of finding a bullet in the body were it not for x-ray proof that it was not there. The alleged case of a British soldier in the Boer War is of interest. This patient suffered a wound occasioned by a single bullet. The wound of entrance was in one heel and the one of exit in the opposite heel, the only explanation being that the bullet traveled up the leg across the pelvis and down the other leg. Bullets or portions of shrapnel which are buried in the soft parts in proximity to a nerve or in a situation where weight bearing is common, as in the foot or in the buttocks, frequently cause pain and must be removed on that account. The fate of a foreign body depends to a great extent upon the organisms which are carried in with it. Many small foreign bodies, however, cause absolutely no symptoms, and need not be removed unless the patient demands their removal and there appear to be psychological reasons for doing so. During the war the French Government found that many such innocent foreign bodies had to be removed if the soldier were to feel that he had recovered. Wounds made by cartridge wadding, which is fired from a blank cartridge, may be very trivial externally and the surgeon may be misled into thinking that no foreign body is present. In all such cases, however, it is important to explore the wound for the presence of such wadding. A boy placed his finger over the muzzle of his B-B rifle and pulled the trigger. The B-B shot buried itself in the finger-tip. The wound of entrance was scarcely perceptible and had it not been for the unusual amount of pain, x-ray examination which revealed the true condition would not have been made (Fig. 28). It is a very common occurrence for surgeons to break needles during operation and it is extremely important to remove the needle at the time of the accident. If this be not done, needles in the foot or hand may cause considerable pain and, moreover, cause the doctor considerable adverse comment and possibly a lawsuit. In fresh wounds of the face small portions of glass often are not apparent. After the wound has been cleansed a *reasonable* search for glass fragments should be made. It is better judgment, however, to risk the leaving in place of a small glass fragment than to disturb the wound to such an extent that infection may be introduced. Sharp glass fragments which have been overlooked tend to work themselves to the surface where their presence is manifested by a tender swelling. This working to the surface may be accompanied by a suppuration and not uncommonly the foreign body will extrude itself spontaneously. Some glass fragments are visible to the *x*-ray. If, however, the small portion of glass is suspected by reason of the small painful swelling, a search for it should be made under local anesthesia. Foote[1] wisely says, "If the examiner cannot feel the foreign body distinctly, and if he does not cause pain every time he makes a certain pressure, he will do well to postpone operation until more definite symptoms are present or until a radiograph shows the exact situation of the object. Sometimes a patient, feeling pain in a scar, attributes it to the presence of a foreign body, although it is really due to pressure of the scar upon some nerve fibers." Buried wood splinters may be very deceptive. The patient rarely remembers just what happens when a splinter enters and can, with difficulty, describe the shape of the fragment which was broken off outside. Two cases in point are the following: A young woman accidentally struck her foot against a splintered piece of wood. A very small wound resulted and she thought nothing of it until the foot became painful, red, and swollen. Her physician admitted her to a hospital where under moist fomentations the redness and swelling subsided but the tenderness along the dorsum of the foot did not disappear. Finally under local anesthesia an exploratory incision was made and a splinter 2 inches long was withdrawn. A boy while swimming stubbed his toe against a sharp piece of wood and wounded the distal end. Infection

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[1] Martin, W.: Ann. Surg., 63, 24, 1916.

[2] David, I.: Jour. Ceylon Brit. Med. Assoc., Colombo, 14, 56, 1917.

[3] Rubesch: Beitr. z. klin. Chir., 80, 1912, quoted by Martin.

[4] Saint-Avid, P. de, and Leonard, R.: Presse méd., 34, 532, April 28, 1926.

[5] Liebe, G.: Münch. med. Wchnschr., 62, 735, 1915.

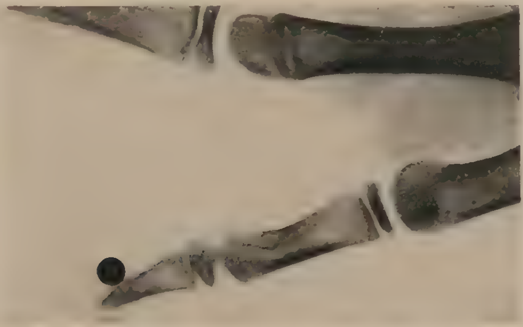

Fig. 28.—B-B shot in finger-tip.

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[1] Foote, E. M.: A Text-book of Minor Surgery, D. Appleton & Company, New York and London, 1912.

of the toe resulted, which had somewhat the characteristics of a paronychia. The appearance of the nail itself was entirely normal. After a week of hot wet dressings, there being no improvement, it was decided to remove the nail. Buried under the nail and entirely invisible from the outside was a wooden splinter 2 cm. long by 4 mm. in diameter. A very common accident is for children to have buried splinters in the buttock, as a result of sliding down rough boards. The child may have no memory of the accident whatsoever and the mother's attention is called to it by his reluctance to be seated at the dinner table. Examination will reveal a very small wound on the buttock, the neighborhood of which is tender to palpation. The diagnosis of a buried splinter may be made with reasonable certainty.

METHODS OF REMOVAL OF FOREIGN BODIES WHICH HAVE ENTERED THROUGH WOUNDS

1. **Direct search** will reveal many small particles of glass or needles which have been buried in wounds. This operation must not be undertaken lightly and the patient should be advised of its difficulty and of the chances for failure. It must not be undertaken without proper assistance, proper lighting, *x*-rays, fluoroscope, and proper instruments. The wound should be made as dry as possible and if necessary a tourniquet should be applied. It is extremely important to remember not to persist in an unsuccessful search over too long a period. In patients an overzeal in this regard has brought about serious damage to the soft parts. It is better to start afresh a second time after renewed efforts at localization. In the case of needles and other particles opaque to the *x*-ray localization by means of *x*-ray plates will be extremely useful. A great variety of ingenious methods have been described. Many of these include the placing of opaque markers, as metal rings, hypodermic needles buried in the flesh, etc., to facilitate the *x*-ray localization. These methods have been carefully described by de Tarnowsky.[1] The six chief methods in use are: First, the two-wire double tube shift method; second, the parallax method; third, tube shift method with medium triangulation; fourth, the profundometer; fifth, the Hirtz compass, and sixth, the cannula and trocar with harpoon. The Girdner or Alexander Graham Bell telephone probe was described by Davidson[2] in 1915, and Bulkley[3] in 1917. The searching probe is connected to

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[1] de Tarnowsky, George: Emergency Surgery, Lea & Febiger, Philadelphia and New York, 1926, p. 602.

[2] Davidson, Sir J. M.: Lancet, London, 1, 217, 1915.

[3] Bulkley, K.: Surg., Gynec., and Obst., 24, 366, 1917.

ear-pieces on the surgeon's ears, and when contact is made with the foreign body a click is heard. Davidson said that the telephone probe was suggested to him by an article in the London Lancet of January 20, 1883, which described attempts to determine by electrical means the position of the bullet in the body of President Garfield in the two months which elapsed between his wounding and his death in the summer of 1881.

A method in vogue during the war, but not at present generally available, is the use of an electrical vibrator. This instrument when brought in the neighborhood, say 3 or 4 inches, of the foreign body, which is made of steel, will cause this foreign body to vibrate in the tissues, and the palpating finger when placed in its neighborhood may feel the foreign body vibrate and in this way localize it.

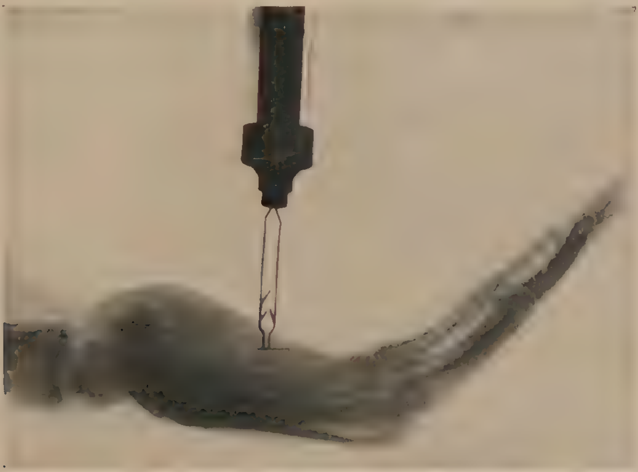

Fig. 29.—Wright electrical localizer for metallic foreign bodies. Localizer making contact with broken needle. (Wright, V. W. M., Jour. Amer. Med. Assoc., 90, 484, March 17, 1928.)

Another method is a recently devised instrument which may be introduced into a wound. This has two electrical contact points; when both of which are placed in contact with a metal foreign body will close the circuit and cause to light a small electric light bulb in the handle of the instrument. It was described by Wright[1] (Fig. 29). Webb[2] devised a method of removing broken needles from fingers. After anesthetizing the finger with novocaine and applying a tourniquet a small incision enlarging the wound of entrance, or over the previously observed tender point, was made. The room is then darkened and a sterile black cloth with a hole 1 cm. in diameter in the center is placed over the upturned reflector of a goose-neck electric light. When the finger is placed over this opening and the wound edges are tetracted, the finger is illuminated in its interior. Pressure is then made with a probe in its various parts and the foreign body is located by its shadow and is readily removed.

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[1] Wright, V. W. M.: Jour. Amer. Med. Assoc., 90, 484, March 17, 1928.

[2] Webb, R. C.: Jour. Amer. Med. Assoc., September, 1916.

Susani[1] praises a method of removing needles, which, to the writer, would seem to be very difficult. A hollow needle, such as an aspirating needle or large hypodermic needle, is passed *over* the needle in the tissues, by means of the fluoroscope and as the former is withdrawn, the latter comes with it as the stylet of a needle.

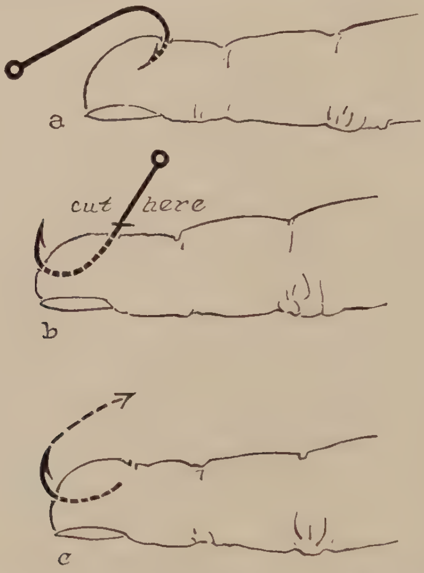

Fig. 30.—Removal of fishhook embedded in finger: *a*, The barb prevents withdrawal; *b*, hook pushed on through the finger and shank cut off; *c*, tip pulled on through.

Several methods have been devised to remove *fishhooks* so buried in the skin that the barb is below the surface. The most practical way is to force the fishhook on through the skin so that the point and barb project out above the skin. The point or the shank is then clipped off with a scissors or a wire cutter and the part in the finger is withdrawn (Fig. 30). Susani recommends passing over the point of the barb a hollow needle, such as an aspirating needle. The fishhook may then be withdrawn as it entered (Fig. 31).

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[1] Susani, O.: Zentralbl. f. Chir., 53, 791, March 27, 1926.

2. Fluoroscopic Removal of Needles and Other Foreign Bodies.—In describing his combined fluoroscopic and direct vision method of removingforeign bodies Fitzwilliams[1] aptly has said that localizers and electric probes are of little value. No attempt should be made to remove any needle or foreign body without having the assistance of a fluoroscope immediately available, unless the case be one where the maneuver described by Doran[2] may be employed. In a few cases Doran was able to force the point of the needle up through the skin and thus withdraw it. Bettman's[3] operating fluoroscope is extremely useful if available. The fluoroscopic screen is attached to the head and is provided with a hinge so that it may from time to time, as may be necessary, be moved aside to permit direct vision. It is best to undertake the removal only in the fluoroscopic room. A standard technic is as follows:

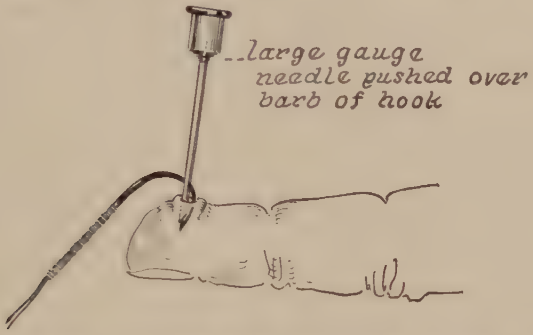

Fig. 31.—Method of removing fishhook by passing large gauge hypo needle over barb. (Susani.)

If the needle be in the hand or extremity and be of such density as to be visible with the fluoroscope, the surgeon is fortunate. However, in a very fat individual with a very thin needle, such as a hypodermic needle, the fluoroscope may have no value at all. The extremity is first carefully cleansed and painted with iodine and is so draped that it may be moved in all directions without contaminating the field. An *x*-ray plate has been made previously and the most probable site of the foreign body is decided upon (Fig. 32). Under local anesthesia an incision $\frac{1}{2}$ inch long is made over this site. A small artery forceps is then inserted into this wound in the supposed direction of the foreign body (Fig. 33). The surgeon carefully holds the artery forceps in place and the room is darkened. After a sufficient interval to accustom the eyes to the darkness, the fluoroscopic screen is held over the extremity, care being used not to touch the surgeon's hands or instruments and contaminate them. A sterile towel may be placed over the surgeon's hands. By means of the fluoroscope the surgeon then attempts to force the tip of his hemostat, *without* opening it, down to the foreign body. When he has reached the foreign body he opens his hemostat and attempts to fix the foreign body in its grasp (Fig. 34). Assurance that he has grasped the foreign body may be obtained by moving the hemostat and seeing the needle move with it as one piece. This procedure sounds simple but may be extremely difficult because of the poor stereoscopic vision. The surgeon may find that his hemostat is $\frac{1}{2}$ inch above or below the foreign body and may be considerably perplexed to find out why he does not grasp it. It is important in operations of this type to caution the *x*-ray technician in advance to keep track of the time which the fluoroscope is used. It is very easy to insist that the fluoroscope be kept on longer than is safe for the surgeon's hands or the

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[1] Fitzwilliams, D. C. L.: Clinical Journal, London, 53, 594, 1924.

[2] Doran, A.: St. Bartholomew's Hosp. Reports, 12, 113, 1876, London.

[3] Bettman, R. B.: Surgical Clinics of North America, 1, 1163, 1921.

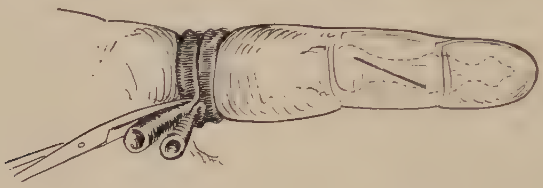

Fig. 32.—Removal of foreign body in the finger. Constrictor applied prior to injection of local anesthetic solution. de Takáts and others believe the constrictor to be unnecessary and painful when a nerve-block anesthesia is done.

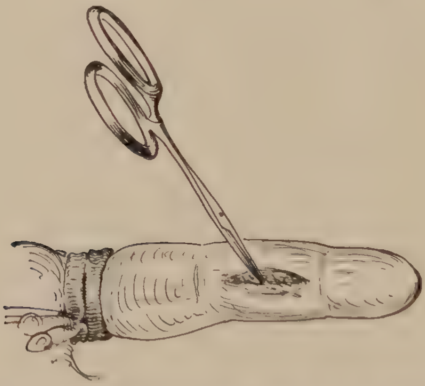

Fig. 33.—The skin incision has been made under local anesthesia. The mosquito forceps is inserted into the wound in the approximate location of the foreign body under direct vision.

patient. A safe total time limit is eight minutes, but this is subject to variations according to the type of x-ray machine used. Moreover, the surgeon dare not use this type of procedure too often himself for fear of x-ray burns. After the foreign body has been grasped by the hemostat *no attempts should be made to forcibly withdraw it.* The room should be relighted, the fluoroscopic screen removed, and using the hemostat as a guide the surgeon should carefully dissect down the wound until the needle comes *into view.* At this point the needle should be grasped by *one end* and carefully withdrawn (Fig. 35). Overhaste in attempts to remove the needle frequently have caused it to be broken

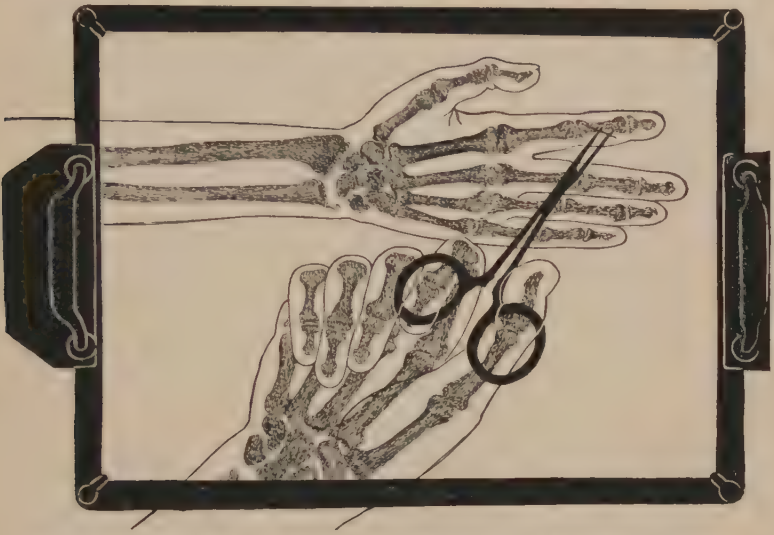

Fig. 34.—Foreign body grasped by hemostat by aid of fluoroscopic vision.

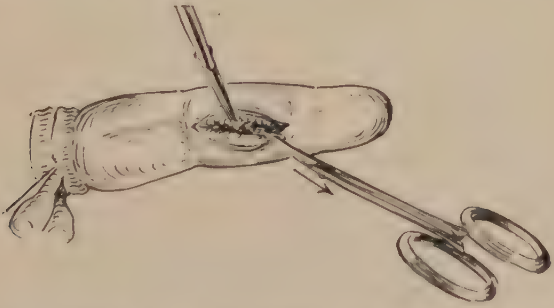

Fig. 35.—The hemostat which has grasped the foreign body is used merely as a guide. The foreign body is exposed by careful dissection and is removed by a second hemostat.

in several parts and greatly added to the difficulty of the operation. The wound may be closed by a few sutures and generally without drainage.

Broken Spinal Puncture Needles.—Spinal puncture needles are not infrequently broken. This accident may occur as the result of a defective needle, as from internal rusting, or because of a sudden movement of the patient. Wayne Babcock[1] says that the safest materials for spinal puncture needles are nickeloid, iridium-platinum, or the more flexible rustless steel alloys. The fragment of the needle should be removed as soon as possible. Local anesthesia is feasible for this purpose, but general is to be preferred. The dissection will be careful, and will be guided by roentgenograms and by traces of rust along the needle tract. "Fortunately, the portion of the needle is rarely as difficult to remove as a bit of needle from the hand or the deep tissues of the arm" (Babcock).

Rings on Swollen Fingers.—In cases where children have worked a tight ring on a finger or in individuals where an injury has caused a finger which bears a ring to swell it will be necessary to remove the ring. Often this can be done by gently massaging the edema of the distal part of the finger back under the ring and by anointing the finger with vaseline or soap. More often it will be necessary to remove the ring by filing. When this is the case a nail-file or other flat object should be passed under the ring, if possible, to protect the finger during the filing. If the cut ring cannot be divulsed it will have to be filed in two places.

FOREIGN BODIES IN THE ORIFICES

Eye.—All varieties of small foreign bodies may be found "in the eye." A bent pin used as a missile for a sling shot has been known to penetrate the eyeball. Steel fragments which have been loosened by hammering steel, portions of emery from emery wheels, are common foreign bodies which enter the eye. Cinders may be found either in the upper or lower conjunctival sac. In the search for a cinder the lower lid should first be pulled down and the cinder may be apparent immediately and removed on the tip of a small, tightly wound cotton applicator which is preferably moistened with boric solution. If it is not apparent on the lower lid, the upper lid should be everted. This is done by having the patient look down and then, by grasping the eyelashes, turning back the upper lid over a small applicator or probe (Fig. 36). The foreign body if present is then generally seen and may be removed with a (moistened) cotton swab. In apprehensive individuals it may be necessary first to instil a drop or two of 2 per cent. cocaine solution. In case the cinder is not sighted, the surgeon should look for the foreign body embedded in the cornea. This generally can be seen with a magnifying glass under oblique illumination. The patient, moreover, will frequently say that he is free of pain when the eyelids are opened but that he feels the scraping on winking. It is far better to refer all such cases to an ophthalmologist, as unskilful attempts to remove a foreign body from a cornea may cause infection or perforation of the anterior chamber. When, however, it is necessary to attempt it, it should be done under cocaine anesthesia with the best illumination possible and with the aid of a magnifying glass. A sterile tiny sput or a scalpel with not too sharp a point or even a cotton applicator is useful. After removal of foreign bodies from the eye, $\frac{1}{2}$ to 2 per cent. mercurochrome or 5 per cent. argyrol should be instilled by the surgeon with instructions to wash the eye with saturated boric solution by means of an eye-cup, several times daily. Some authorities prefer to wash by means of an eye-dropper, believing that the eye-cup in the hands of the laity is uncleanly.

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[1] Babcock, Wayne: Surgical Clinics of North America, 8, 803, August, 1928.

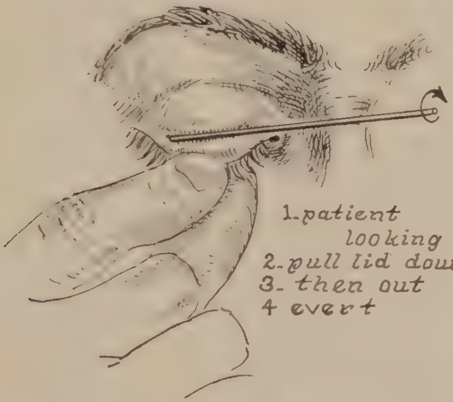
1. patient
looking down
2. pull lid down
3. then out
4 evert

Fig. 36.—Eversion of upper eyelid. The patient is instructed to look down. The lashes are grasped and the gentle pressure is made upon the lid with a toothpick or a match stick. The lid is then everted.

Nose.—All manner of foreign bodies are introduced into the nostrils by children. Bolts, nuts, screws, beans, and particularly marbles find their way into the noses of children. The removal of such foreign bodies may be extremely difficult and the difficulty is greatly augmented if there has been considerable delay after the accident and edema and infection have occurred. A unilateral nasal discharge is always suggestive of a foreign body (Vaughn and Burnham). Many such foreign bodies may be removed by encouraging the child forcibly to blow his nose with the opposite nostril occluded. Small sharp objects may be grasped and withdrawn by hemostat. Round objects, as marbles, are handled by a curet or hook which may be formed by a bent probe and which are insinuated behind the object. In many cases it is necessary to push the foreign body back into the pharynx and remove it through the mouth, taking care that it does not slip back into the throat. Where considerable swelling has taken place, the turbinates are shrunk by 3 per cent. ephedrine or cocaine solution before an attempt to remove the foreign body is made.

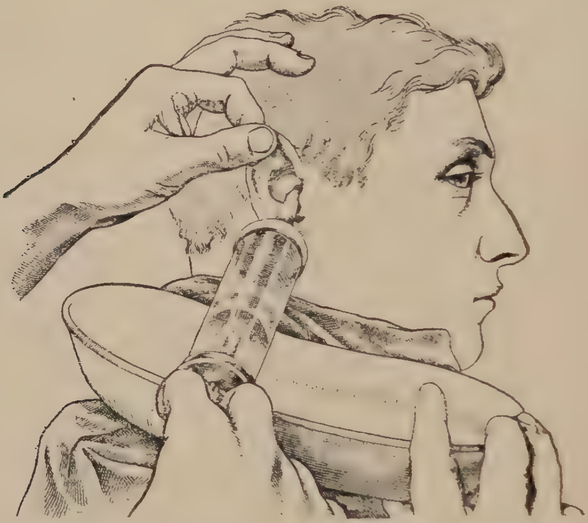

Fig. 37.—Irrigation of the external auditory meatus. Warm water or saline is useful in the removal of inspissated wax. (Maisonnet, "Petite Chirurgie.")

Ears.—Children may introduce small objects into the external meatus, and their presence will become evident by pain, swelling, and occasionally by discharge. Small insects may enter the external meatus and remain there and deposit their eggs. The small foreign objects may be removed under direct vision with a small forceps. Insects, when alive, will sometimes come out of the ear if a bright light is placed near the opening of the canal. Insects may be killed by the introduction of olive oil and their removal be effected by syringing with warm water. Impacted or inspissated wax in the ear is most generally removable by copious and continued irrigations of warm water (Fig. 37). Large plugs occasionally have to be removed by grasping with a forceps. The latter procedure may be best trusted to an otolaryngologist.

Pharynx and Esophagus.—Coins, toy bicycles, and other small objects may become lodged in the pharynx or esophagus. Fishbones may be caught in the act of swallowing and may penetrate the mucous membrane in the region of the tonsillar pillars or in the posterior pharynx. The introduction of a finger into the pharynx may permit the hooking out of a foreign body or it will often bring about such violent gagging and vomiting as to extrude it. If, however, this is not effectual, a curved forceps should be introduced into the mouth and under the guidance of the palpating finger should grasp and remove foreign body. Fishbones, if visible, may cautiously be removed by a forceps. Occasionally the aid of a laryngeal mirror may be required. A swallowed fishbone may cause a wound of the pharynx that for a few days makes the patient think he has an embedded fishbone, but the symptoms will subside. The tonsils and base of the tongue are common sites of pin or fishbone lodgment.

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McReynolds[1] reports the case of an intoxicated individual in whom the full upper tooth plate became accidentally lodged in the upper part of the esophagus. Heyd[2] reports the case of a girl of fourteen years who swallowed a $2\frac{1}{2}$-inch black-headed pin. On laparotomy the point of the pin was found to be perforating the jejunum. It was successfully removed. In Palmer's[3] case an eight-month-old-baby swallowed a $1\frac{1}{2}$-inch open safety-pin. It was observed roentgenologically until it passed safely. Palmer believes that "in the majority of instances one can count on the passage of a foreign body through the intestine if it has been able to pass through the pylorus." A nail swallowed by a two and one-half year-old child passed in fourteen days.[4]

Trachea.—Patients with large foreign bodies which completely obstruct the trachea rarely survive long enough to reach the physician's hands. Foreign bodies which partially obstruct the trachea and merely cause a wheezing and embarrassment of respiration do not immediately threaten life and they can be removed with more deliberation. Rounded objects, such as coins and beans, occasionally may be expelled by inducing the patient to cough. Sometimes they may be removed by means of the laryngeal mirror and a long curved forceps. This, of course, is best accomplished in the hands of a trained laryngologist. Chevalier Jackson[5] has made the most valuable studies of foreign bodies in the air- and food-passages. He has removed the foreign bodies through the laryngoscope, the bronchoscope, and the esophagoscope. Of 628 cases 98.1 per cent. were successful. The operative mortality was less than ½ per cent. One of his most interesting cases was that of a woman who had had a glass collar button in her lung for twenty-six years. Septic toxemia had reduced her weight to 98 pounds. She regained perfect health after removal and reached the weight of 182 pounds.

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[1] McReynolds, G. S.: Jour. Amer. Med. Assoc., 87, 407, August 2, 1926.

[2] Heyd, C. G.: Surgical Clinics of North America, 1, 547, 1921.

[3] Palmer, D. W.: Jour. Amer. Med. Assoc., 70, 480, 1918.

[4] Rosenbaum, G.: New York Med. Jour., 97, 918, 1913.

[5] Jackson, C.: Surg., Gynec., and Obst., 28, 201, 1919; also Ann. Otol., Rhinol., and Laryngol., 33, 100, 1924.

On rare occasions the surgeon may see a case of complete tracheal obstruction very shortly after its occurrence. Patient is cyanotic and *in extremis.* A few brilliant results have been recorded after immediate and urgent tracheotomy. An infant in the neighborhood of the Johns Hopkins Dispensary was rushed there in his mother's arms immediately after the lodgment of a bean in his trachea with a complete obstruction. The resident physician, sensing the urgency of the situation and the futility of waiting for aseptic preparation, did a tracheotomy with his pocket knife and saved the baby's life. Tucker[1] reports a case of a child with a "kewpie" doll in his larynx. The patient was saved by urgent tracheotomy and the doll removal later. Where urgent tracheotomy is necessary the patient should first be placed on the table so inclined that the head is downward at an angle of at least 15 degrees. This is done in order that any blood entering the trachea will run out into the mouth instead of down into the lungs. With a good light and what assistance may be available an incision is made in the midline of the neck in the lower half and directly over the trachea, precaution first having been taken to produce upward traction on the thyroid cartilage. Two or three of the cartilaginous tracheal rings are cut through at a distance of some 2 cm. below the thyroid cartilage. If a tracheotomy tube be available, it is inserted. If no tracheotomy tube is at hand, hairpins bent to form small retractors may be used to divulse the cut edges of the trachea, and breathing may be established without the insertion of a tube. In some instances it will be necessary to clip a small portion of the ring on each side so as to make a circular hole in the trachea. The convulsive inspiratory efforts of the patient will often cause the rings to collapse and shut off the trachea. This accident does not occur when the tracheotomy tube is in place, but in the absence of a tracheotomy tube it may be avoided by suturing the cut margins of the trachea up to the overlying muscles, or by the insertion of a twisted hairpin self-retaining retractor.[2] In cases where tracheotomy tubes have been used it is important to accurately instruct the nurse in charge of the patient as to the details of cleansing the inner tube.

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[1] Tucker, G.: Medical Clinics of North America, 10, 121, July, 1926.

[2] Moorhead, J. J.: Traumatic Surgery, W. B. Saunders Co., Fig. 523.

Guisez[1] warns that "the death of young children from bronchopneumonia or purulent pleurisy, due to the presence of an intrabronchial foreign body, is of more frequent occurrence than might be supposed." An unexplained bronchopneumonia should arouse suspicion of the presence of a foreign body *even if the latter be undisclosed by the x-ray,* and bronchoscopy should be instituted.

Esophagus.—Foreign bodies in the esophagus which have sharp points are best removed by means of esophagoscope and forceps. It is surprising, however, how many coins, open safety-pins, needles, and tacks will pass, without apparent injury to the esophagus, into the stomach and, in fact, through the entire gastro-intestinal tract. Certain sharp objects which are embedded in the walls of the esophagus will require esophagotomy for removal. By careful use of an esophageal bougie, or a stomach-tube, or by swallowing lumps of bread or potatoes rounded objects may be forced on into the stomach, where they are more safely situated. Wishart[2] quotes Chevalier Jackson's list of the things which should *not* be done when a patient is suspected of swallowing a foreign body:

"1. Do not reach for the foreign body with the finger, lest the foreign body be thereby pushed into the larynx, or the larynx be thus traumatized.

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"2. Do not make any attempt at removal with the patient in any other position than the recumbent, with the head and shoulders lower than the body.

"3. Do not hold up the patient by the heels, lest the foreign body be dislodged and asphyxiate the patient by becoming jammed in the glottis.

"4. Do not fail to have a radiograph made, if possible, whether the foreign body in question is of a kind dense to the ray or not.

"5. Do not fail to search endoscopically for foreign body in all cases of doubt.

"6. Do not pass an esophageal bougie, probang, or other instrument blindly.

"7. Do not tell the patient he has no foreign body until after radiography, physical examination, indirect examination, and endoscopy have all proved negative."

Minor surgery is not concerned with those cases of multiple foreign bodies in the stomach which require gastrotomy for removal. Dr. W. S. Halsted removed 208 foreign bodies and 74 gm. of glass from the stomach of a patient, and many other similar instances are recorded.

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[1] Guisez, Jean: Presse méd., 35, 642, May 21, 1927.

[2] Wishart, D. E. S.: Canad. Med. Assoc. Jour., 18, 415, April, 1928.

Urethra.—Many small foreign bodies may be removed from the male and female urethra by means of a urethroscope and a small long forceps. The urethra at the base of the penis must be compressed during this maneuver to prevent the foreign body slipping into the bladder (Foote). It may be necessary, however, in some cases to do an external urethrotomy in the male. Not uncommonly common pins are introduced head foremost into the urethra. When this occurs it is impossible to force them out because of the pin point engaging in the walls of the urethra. When this occurs a useful maneuver is to force the pin point entirely through the wall of the penis and by reversing its direction expel the head in through the meatus.

Bladder.—Foreign bodies, such as hairpins, nails, etc., which have been introduced into the bladder, occasionally may be removed by means of a cystoscope and forceps. Softer objects occasionally may be crushed by the lithotrite. Suprapubic cystotomy under direct vision, however, is a much safer procedure than protracted intra-urethral instrumentation.

Rectum.—General anesthesia is frequently necessary for the removal of foreign bodies from the rectum. With extreme caution the sphincter ani should be dilated. This is done by first inserting one gloved and well-vaselined finger in the anus. The anesthetist is cautioned that the sphincter is being dilated because the marked stimulating effect on respiration caused by dilatation of the sphincter may cause the patient to inhale greater quantities of anesthetic than is desirable. After the first finger has been introduced, the second, third, and finally the fourth fingers are simultaneously introduced. By means of a rectal speculum the foreign body may be visualized and grasped and removed or occasionally it may be extracted by means of a finger inserted into the rectum or by a forceps guided by the finger. Impacted feces generally may be removed digitally without anesthesia.

Vagina and Uterus.—Small foreign particles in the vagina generally may be removed by irrigations with warm solutions, or by means of a vaginal speculum and forceps. Pessaries which have been left in position for a long time and which have become partially embedded in the folds of the mucous membrane of the vagina will often have to be cut to pieces by a bone-cutting forceps before their removal can be effected.

Penis.—The penis occasionally is injured by having a ring passed over it. Resulting congestion may prevent the removal of the ring and may even obscure it. The ring will have to be filed or cut in two places.

CHAPTER IV

FURUNCLES AND CARBUNCLES[1]

Several criteria are employed in the estimation of the value of a treatment. The criteria from the patient's standpoint, named in decreasing order of their importance, are: (1) The amount of pain; (2) the extent of the interference of the treatment with the patient's work; (3) the degree of inconvenience caused by the dressings; (4) the length of time required for recovery; (5) the size of the scar; (6) the need for a general anesthetic, and (7) the expense of the treatment. From the doctor's standpoint must be considered: (1) The amount of skill required; (2) the practicability of the treatment for practitioners with limited facilities, and (3) the practicability of the treatment in large hospitals where every facility is available.[2]

The furuncle is the site of a conflict between the invading staphylococcus and the natural defensive forces of the body. There is no fundamental difference between a boil and a carbuncle. The difference is due solely to anatomical and mechanical factors. The carbuncles differ because of the tough skin connected to the underlying fascia by strong vertical septa.[3] Theoretically, therapy has but two objects—to destroy or weaken the staphylococcus and to augment the protective mechanisms of the body. Practically, however, it is necessary to consider in the treatment the assuaging of pain and the general convenience of the patient. The infecting organism comes from without and passes through a portal of entry in the skin, generally a hair follicle, and the reaction to its invasion depends upon the virulence of the particular strain of bacteria, the state of the defensive forces of the host, and the anatomical peculiarities of the site invaded.

There are all gradations between pimples and malignant carbuncles. The reaction of the tissues to the staphylococcus is either cellulitis, suppuration, or necrosis.[4] The "core" or slough is composed of dead tissue and dead cells. The early prognosis of a furuncle, according to

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[1] This chapter is based upon an article by the author in International Abstract of Surgery, May, 1928.

[2] Carp, L.: Ann. Surg., 86, 702, 1927.

[3] Lee and Downs: Southern Med. and Surg. Jour., 89, 425.

[4] Sabourand, R.: Ann. de dermat. et syph., 6, 417, 1925.

Schutz,[1] depends upon: (1) The area of infiltration; (2) the intensity of the pain, and (3) the amount of systemic disturbance. Severe pain is not, however, a marked symptom of many very serious carbuncles of the neck. The situation of the furuncle is an important factor in its seriousness. As is well known, furuncles of the face, and particularly those of the upper lip, have a high mortality.[2]

Hinton[3] has made very clear the anatomical proximity and relations of the anterior facial vein and its branches to the cavernous sinus. From the facial vein blood and organisms may pass by way of the inferior ophthalmic vein and the angular and superior ophthalmic veins by a sort of retrograde thrombosis. The mortality of furuncles of the face has been variously estimated. Of 103 cases treated on Payr's service in the period from 1913 to 1924, 10.7 per cent. were fatal.[4]

Cabot's[5] recent case is illustrative of the danger of traumatism in furuncles of the upper lip. A boy of seventeen years picked a small pustule of the upper lip. The next day a small incision was made. Tremendous swelling then developed and the patient became stuporous. The white blood count varied between 23,000 and 39,000, and when the patient died six days later there was pus in the cavernous sinuses. In Comer's[6] case the patient picked and squeezed a furuncle of the anterior nares, and death ensued three or four days later. Turner and Reynolds[7] report one death in 63 cases of furuncle of the nasal vestibule, a mortality of 1.5 per cent. In the fatal case a small boil appeared upon the inner aspect of the right ala nasi. Two days later it burst, with a free discharge of pus. On the following day headache, vomiting, and protrusion of the eyeballs occurred. Death resulted six days after the onset.

Kauffmann[8] found the mortality of furuncle metastases to be about 12 per cent., considerably lower than Riedel's estimate of 25 per cent. The *locus minoris resistentiæ* inviting the metastases was generally the site of a hemorrhage, and the prognosis was most serious in the cases in which the inner organs were involved.

Although accurate classification is impossible, the treatment of furuncles and carbuncles may be considered under the following heads:

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[1] Schutz, J.: Münch. med. Wchnschr., 73, 1235, 1926.

[2] Demel, R., and Heindl, A.: Deutsche Ztschr. f. Chir., 198, 379, 1926.

[3] Hinton, J. W.: Ann. Surg., 85, 104, 1927.

[4] Morian, R.: Deutsche Ztschr. f. Chir., 193, 45, 1925.

[5] Cabot: Boston Med. and Surg. Jour., 196, 1009, 1927.

[6] Comer, M. C.: Southwestern Medicine, 11, 310, 1927.

[7] Turner, A. L., and Reynolds, E. E.: Jour. Laryngol. and Otol., 41, 73, 1926.

[8] Kauffmann, H.: Beitr. z. klin. Chir., 138, 276, 1926.

- I. Prophylactic treatment.
- II. Local treatment:
  - (*a*) Mechanical:
    - 1. Incision by knife, including excision.
    - 2. Incision by cautery, including excision.
    - 3. Ignipuncture (glow-needle).
    - 4. Sounding and dilatation.
    - 5. Phenol probe.
    - 6. Rest; avoidance of trauma.
  - (*b*) Chemical:
    - 1. Cataplasma and softening poultices:
      - (*a*) Unguents.
      - (*b*) Pepsin.
      - (*c*) Pancreatic ferments.
    - 2. Hypertonic solutions:
      - (*a*) Saturated boric acid solution.
      - (*b*) Aluminum acetate.
    - 3. Antiseptic plasters and applications:
      - (*a*) Phenol.
      - (*b*) Iodine.
      - (*c*) Ichthyol.
  - (*c*) Heat:
    - 1. Hot fomentations.
    - 2. Dry heat.
  - (*d*) Irradiation, diathermy, etc.:
    - 1. *x*-Ray.
    - 2. Ultraviolet light.
    - 3. Diathermy.
  - (*e*) Biological:
    - 1. Autoblood circuminjections.
    - 2. Vacuum cupping.
    - 3. Bier's hyperemia.
    - 4. Horse serum.
    - 5. "Histoplast."
    - 6. Local immunity.

- III. Systemic treatment:
  - (*a*) Biological:
    - 1. Vaccines.
    - 2. Insulin.
    - 3. Blood.
    - 4. Non-specific protein therapy.
  - (*b*) Pharmaceutical:
    - 1. Sulphur.
    - 2. Tin.
    - 3. Manganese.
    - 4. Quinine.
    - 5. Mercury.
    - 6. Mercurochrome.
    - 7. Turpentine.
  - (*c*) Dietetic measures, laxatives, fluids, rest.

- IV. Anesthesia in furuncles and carbuncles.

I. PROPHYLACTIC TREATMENT

Under the heading of prophylactic treatment may be mentioned, first, strict bodily cleanliness. More specifically, where pus has come in contact with the skin, as in the neighborhood of a discharging furuncle, the skin must be scrupulously cleansed, preferably with soap and water, and washed with alcohol. All epithelial defects or abrasions must be avoided. Shaving with a dull razor traumatizes the hair-root follicles. Men, whose stiff collars cause skin friction, are much more susceptible to furuncles of the neck than women, who wear soft low collars. All abrasions and small wounds should be treated with antiseptics. Caution must be observed in the use of adhesive to fasten dressings to discharging wounds since furuncles may develop beneath it. As will appear later, dietary precautions, particularly those which may cause a lowering of the blood sugar, may be of value. Treatment with the Roentgen ray and with autogenous and polyvalent vaccines may be included under the head of prophylactic treatment, but will be given more detailed consideration later.

II. LOCAL TREATMENT

Opinion is divided as to the wisdom of incising furuncles and carbuncles. Lee and Downs[1] believe that there are two indications in the treatment of all pyogenic infections—the relief of tension and the removal of dead tissue. The situation of the lesion is, of course, of importance. Livingston[2] advises immediate excision of the necrotic tissue by a double crucial incision. He undercuts the lateral flaps in such a manner that they may be approximated by adhesive plaster, as granulation progresses, to bridge over the skin defect. The under cutting of the skin flaps is important in order that all the diseased fat columns may be opened (Fig. 38). Loose gauze packing for a couple of days is desirable in order to divulse the flaps. Dakinization of the wound with secondary suture is employed by some surgeons[3] (Fig. 39). As the sloughs become separated they are lifted out of the wound or their redundant parts are cut off. They should not be forcibly pulled out, as not only is it painful and unnecessary, but also it is liable to cause bleeding and to open new channels of infection. Webb[4] has suggested treating the sloughing base of a carbuncle with an aqueous solution of commercial "caroid" (American Ferment Co.). He states that the necrotic tissue will dissolve very rapidly (two or three minutes) under this treatment.

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[1] Lee and Downs: Southern Med. and Surg. Jour., 89, 425.

[2] Livingston, E. M.: Ann. Surg., 64, 663, 1926.

[3] Lee and Downs: Southern Med. and Surg. Jour., 89, 425.

[4] Webb, R. C.: Personal communication.

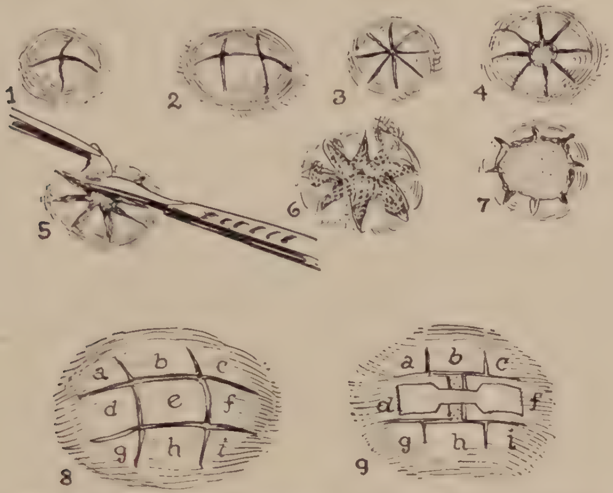

Fig. 38.—Types of incisions for carbuncles: 1, Crucial. 2, Double crucial. 3, Stellate. 4, Stellate with excision of center. 5, Method of undercutting of flaps. 6, Wound loosely packed with gauze. 7, Wide excision of flaps in cases with marked necrosis. 8 and 9, Incision of Livingston. Removal of area *e* and subsequent approximation of flaps *d* and *f*.

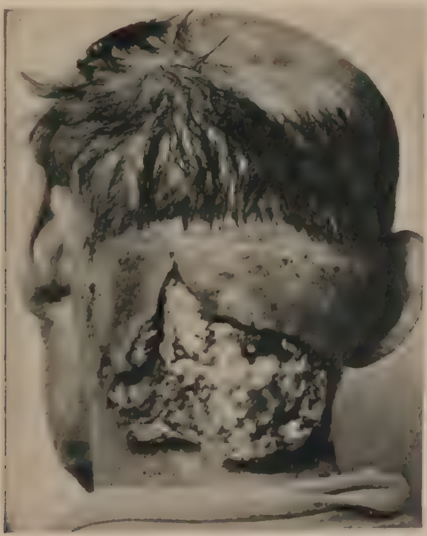

Fig. 39.—Radical excision of carbuncle of the neck.

Objections to the incision of a furuncle or carbuncle include the associated pain, the possibility of opening new channels of infection, the slow healing, the occasional use of a general anesthetic, and the disfiguring scar.[1] Junkerman[2] regards surgery in carbuncles and furuncles as criminal except in cases with fluctuation. In furuncles of the upper lip the evidence is unfavorable to incision. Dittrich[3] found that in 22 of 40 cases of furuncle of the upper lip which were treated by incision, the mortality was 13.6 per cent., whereas in 18 cases in which incision was not done, the mortality was only 5.5 per cent. Melchior[4] collected 73 cases of face furuncles at the Breslau clinic. In the 37 cases treated by incision there were four deaths, and in the 36 cases treated conservatively there was but one death. Melchior believes, however, that incision was done in the more serious cases. He is inclined to the opinion that if the process is progressive, suitable incision is the surest procedure to prevent further propagation.

As is well known, the chief danger in furuncles of the face is cavernous sinus thrombosis and infection by way of the facial vein (Hinton[5]). Traumatism is believed to increase the risk of thrombophlebitis with the meningeal sequelæ. Hofman[6] emphasizes the danger of picking and squeezing. Even the use of a sharp knife may aggravate the condition.

In 1922 first Kritzler[7] and then Schule[8] advocated central cauterization of furuncles with a glowing hot needle (ignipuncture). Koch[9] describes this method as painful but astonishingly valuable. After cleansing of the skin a glowing hot knitting needle is inserted from 6 to 10 mm. into the crater of the furuncle. This is believed to destroy the first focus of infection. Without squeezing, a gauze dressing is applied. Schutz's[10] method consists in sounding and dilating the carbuncle orifices and applying hot compresses. Braun[11] praises the Schutz method, but employs sounds which are hollow and dipped in a solution of iodine, phenol, and turpentine. Dittrich[12] uses a toothpick dipped in phenol, introducing it in the direction of the hairs into the white center of the furuncle. This method is entitled to favorable consideration. Its repeated use has accomplished very satisfactory results in the hands of

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[1] Lotsch, F.: Klin. Wchnschr., 6, 1191, 1927.

[2] Junkerman, K.: Münch. med. Wchnschr., 73, 563, 1926.

[3] Dittrich, R.: Beitr. z. klin. Chir., 132, 671, 1924.

[4] Melchior, E.: Beitr. z. klin. Chir., 135, 681, 1926.

[5] Hinton, J. W.: Ann. Surg., 85, 104, 1927.

[6] Hofman: Arch. f. klin. Chir., 123, 51, 1923.

[7] Kritzler: Deutsche med. Wchnschr., 13, 866, 1922.

[8] Schule, A.: Deutsche med. Wchnschr., 48, 1517, 1922.

[9] Koch, F.: Med. Klin., 20, 183, 1924.

[10] Schutz, J.: Münch. med. Wchnschr., 72, 988, 1925.

[11] Braun, G.: Deutsche med. Wchnschr., 52, 1431, 1926.

[12] Dittrich, R.: Beitr. z. klin. Chir., 132, 671, 1924.

Wolfer[1] (Figs. 40–42). Webb[2] recommends the use of a sewing needle dipped eye end in phenol and then inserted into the carbuncle.

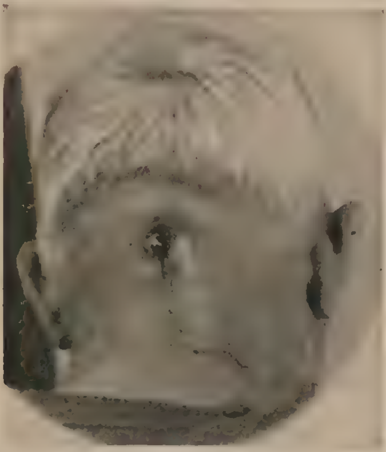

Fig. 40.—Carbuncle of the neck. Condition on admission. (Surgical Dispensary, Northwestern University Medical School. Courtesy of Dr. John A. Wolfer.)

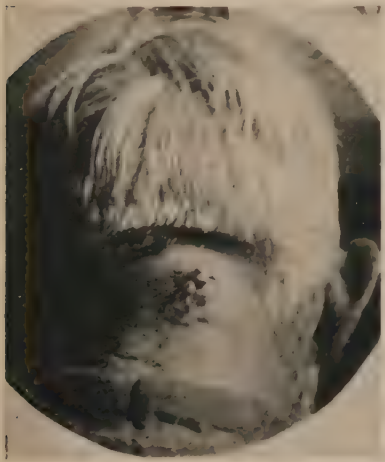

Fig. 41.—Carbuncle of the neck shown in Fig. 40. Condition four days after the institution of the phenol probe treatment. (Northwestern University Medical School. Courtesy of Dr. John A. Wolfer.)

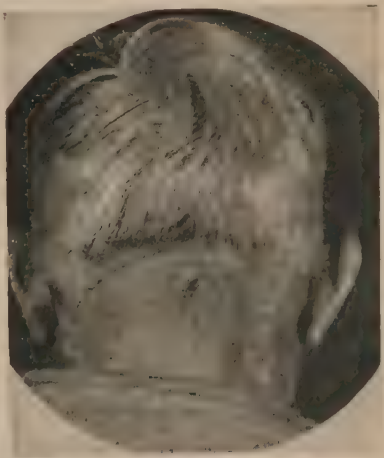

Fig. 42.—Carbuncle of the neck shown in Fig. 40. Condition five days after the institution of the phenol probe treatment. (Surgical Dispensary, Northwestern University Medical School. Courtesy of Dr. John A. Wolfer.)

Long ago Freeman[3] advised the extraction of the central hair or opening of the superficial pustule and the introduction of 95 per cent.

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[1] Wolfer, John A.: Personal communication.

[2] Webb, R. C.: Personal communication.

[3] Freeman, L.: Keen's Surgery, Philadelphia, W. B. Saunders Co., 1, 257.

carbolic acid. Perret[1] repeatedly applies on the furuncle 1 drop of phenol under slight pressure until it corrodes its way into the accumulation of pus. In 1922 Kritzler[2] advocated the application of carbolic acid under slight pressure.

Placing the site of the carbuncle or furuncle at rest is believed to be of first importance. Putting the patient to bed is often a wise procedure. In cases of lip furuncles Dittrich[3] feeds the patient through a tube and prohibits speech in order to keep the affected parts at rest.

Innumerable salves have been devised as applications to furuncles. These cataplasma, or poultices, have been designed to relieve pain, to exert a bactericidal effect, to soften the skin, and to accelerate the opening of the furuncle and the discharge of the central slough or "core." Gray salve (unguentum cinereum), a 33 per cent. mercury ointment, has long been employed.[4] Junkerman[5] applies it in a thick layer on gauze unless stomatitis or nephritis sets in. Zechlin[6] has treated 4000 furuncles by this method. He spreads the salve from 4 to 5 cm. beyond the infected zone and supplements it by hot alum-acetate compresses. A most useful proprietary remedy in the United States consists essentially of 1 per cent. phenol, 9 to 10 per cent. fluidextract of ergot, and 5 per cent. zinc oxide plus a vehicle. Flaxseed poultices are useful as softening agents, but are not aseptic.

A most interesting method of treatment is the application of salves containing the digestive ferments of the intestine. The purpose of these ointments is to macerate and digest the skin in the center of the furuncle and thereby facilitate the discharge of the inner pus or slough. According to Katz,[7] who states that this method was employed first by Unna, the best results are obtained in furuncles and carbuncles, but panaritium (paronychia) is also favorably affected.

While hot saturated boric acid fomentations are still the choice of many clinicians, other hypertonic solutions are also warmly advocated. Canon,[8] in 1924, reported the treatment of 110 cases of furuncles and 18 cases of carbuncles exclusively by immobilization and a dressing saturated with a weak solution of aluminum acetate. A year later[9] he

[1] Perret, C. A.: Schweiz. med. Wchnschr., 55, 469, 1925.
[2] Kritzler: Deutsche med. Wchnschr., 13, 866, 1922.
[3] Dittrich, R.: Beitr. z. klin. Chir., 132, 671, 1924.
[4] Fabry, J.: Münch. med. Wchnschr., 72, 2016, 1925.
[5] Junkerman, K.: Münch. med. Wchnschr., 73, 563, 1926.
[6] Zechlin, T.: Münch. med. Wchnschr., 73, 1742, 1926.
[7] Katz, T.: Deutsche med. Wchnschr., 51, 398, 1925.
[8] Canon: Deutsche med. Wchnschr., 50, 991, 1924.
[9] Canon: Deutsche med. Wchnschr., 51, 991, 1925.

reported that he saw no complications in his series of 129 cases of furuncles (including 21 cases of furuncles on the face) which were treated only by rest in bed and dressings moistened with a solution of aluminum subacetate, whereas in patients who had been operated upon for furuncles he saw several metastatic abscesses.

A method of aborting very early furuncles which is often successful consists in painting the small red, indurated, painful area with full-strength tincture of iodine. Three or four coats may often be used to advantage, the tincture being allowed to dry between applications.[1] Wolfer[2] treats the earliest suggestion of a pyogenic cutaneous infection by anesthetizing the skin with carbolic acid in a very small cross and making in this carbolic cross a very shallow short crucial incision. The use of ichthyol was first advocated by Unna and has many proponents. Kissmeyer's[3, 4] technic is as follows: Each furuncle is first cleaned with alcohol or iodine, and dried and then covered with pure ichthyol. Over the thick oil of the ichthyol, which soon dries, a thin layer of cotton is applied. The little dressing sticks like collodion. The next day the dressing is removed with tepid water and the treatment is repeated. In some cases the dressing is changed twice a day. In cases of large furuncles Kissmeyer uses the galvanocautery and ichthyol. Deep injections of phenol have gained but few adherents.

One of the chief agents in our present treatment of furuncles is heat, particularly in the form of hot fomentations. It is important to give the nurse or attendant explicit directions as to the manner of applying the fomentations. The first requirement is that the dressings be massive so that an area considerably beyond the infected area will be treated. The second requirement is that the dressings be continuously warm and moist. A most convenient procedure consists in applying dressings wrung out of whatever hot solution is employed, covering the dressings with a rubber sheet or oil cloth, and fastening an electric pad on top of all (see Fig. 18). By this method a continuous moist heat is produced and the solution may be added at the corner of the dressing as needed. As a substitute for the electric pad, a hot-water bag or frequent changes of the hot dressings may be used. Heat is greatly appreciated by the patient as a rule. In the treatment of carbuncles Livingston[5] uses dry heat after the first twenty-four hours.

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[1] Pfahler, G. E.: Atlantic Med. Jour., 28, 586, 1925.

[2] Wolfer, J.: Personal communication.

[3] Kissmeyer, A.: Ann. de dermat. et syph., 7, 297, 1926.

[4] Kissmeyer, A.: Münch. med. Wchnschr., 74, 282, 1927.

[5] Livingston, E. M.: Ann. Surg., 64, 663, 1926.

Potter[1] believes that the *x*-ray is useful in the treatment of furuncles in a threefold way: First, in the form of a localized erythema dose, to abort incipient boils; second, in the form of local treatment to hasten the healing and to make well-developed furuncles less painful; third, in the form of a wide light exposure, to act as a preventive and prophylactic.

Ultraviolet light has been tried in furunculosis. Treatment of the crater bed of an excised carbuncle with the water-cooled ultraviolet lamp has a germicidal effect on the superficial organisms. The amount of penetrating effect is difficult to estimate. It is not unlikely that generalized ultraviolet radiations have a beneficial effect in raising the body's resistance to infection, and possibly in diminishing the likelihood of secondary furunculosis in the surrounding skin area.

Following 4 fatal cases of carbuncles in which extensive incision had been done, Laewen[2] in 1923 began to use injections of the patient's own blood. The whole blood was injected at the margins of induration in furuncles after simple crucial incisions. The results were favorable.

In contradistinction to Laewen's autogenous blood injections *with* surgical incisions in carbuncles Carp[3] made an extremely careful study of injections of autogenous blood *without* surgical incisions. He treated twelve definite progressive carbuncles in non-diabetic subjects by the circuminjection of autogenous blood without accessory measures such as incision, local heat, or narcotics. He used a general anesthetic and a sterile needle for each of the three to six intracutaneous and subcutaneous circuminjections. The amount of blood varied from 10 to 70 c.c. and averaged 37 c.c. Carp noted that: (1) The infection did not spread except in 1 case; (2) there was quick relief of the pain and constitutional symptoms; (3) there was no apparent reaction after the injection; (4) most of the slough liquefied; (5) the injected blood seemed to remain in the tissues, undergoing gradual modification for from several days to two weeks; (6) the time for cure was probably shorter than it would have been if a surgical procedure had been used; (7) the patients showed a minimal scar at the time of discharge from the hospital, and (8) the average time for cure was twenty-three days.

A variation of the autogenous blood treatment of Laewen is that of Kuhn.[4, 5, 6] Kuhn believes that Laewen's injections influence the area around the furuncle more than the furuncle itself. In order to distribute the blood more evenly Kuhn uses a vacuum cup with suction strong enough to produce hemorrhages in and around the furuncle. Narcosis often is necessary in his method. Beginning with a negative pressure of from 100 to 200 mm. Hg, the suction is increased to from 400 to 600 mm. Hg. The suction cup is left on for from one-half to four hours. Kuhn has discontinued the incision of furuncles less than 7 to 8 cm. in diameter. Duker[1] has had good results from Kuhn's method. He has used a vacuum as high as one-half to one atmosphere. Because of pain, the vacuum must not be applied too rapidly. Hemorrhages are caused in and around the furuncles. Hans[2] has warned against "maltreatment of furuncles with suction apparatus."

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[1] Potter, H.: Personal communication.

[2] Laewen, A.: Zentralbl. f. Chir., 50, 1018, 1923.

[3] Carp, L.: Arch. Surg., 14, 868, 1927.

[4] Kuhn, F.: Med. Klin., 22, 1957, 1926.

[5] Kuhn, F.: Münch. med. Wchnschr., 74, 451, 1927.

[6] Kuhn, F.: Münch. med. Wchnschr., 71, 1432, 1927.

Following a series of experiments on himself in 1922, von Wassermann[3] announced "histoplast," a preparation containing an extract of the live staphylococcus. This is applied locally to the furuncle. The inflamed focus absorbs the staphylococcus antigen, and after a fifteen- to thirty-minute reaction there is a diminution of the pain. Hofmann[4] used histoplast on seventeen cases and found it to exert a favorable influence upon early furuncles. Saalfeld[5] and Kleeberg[6] also recommended histoplast. Stajano and Hormaeche[7] apply to furuncles a gauze dressing impregnated with an antistaphylococcus vaccine with a concentration of about 10,000 million per cubic centimeter which is made from cultures of Staphylococcus aureus taken from furuncle pus. They claim that the use of this vaccine results in abortion of the infection in many cases and in suppuration and resolution within twenty-four hours in others.

Besredka,[8] of Pasteur Institute, believes that one need not depend upon the production of antibodies in obtaining immunity. The immunization of the "receptive tissues" is more important than to attempt to increase the quantity of antibodies in the blood.

"The staphylococcus, which is accustomed to live in symbiosis with the mucocutaneous tissue, penetrates the lymphatic vessels of the skin, just as soon as it has sustained the slightest injury. Having entered the lymphatic current, the staphylococcus creates a lymphangitis. Upon reaching the glands it meets the phagocytes, where it is digested and destroyed. After a slight reaction the lymphatic glands return to their normal aspect, or the microbe gains the upper hand, passes the glandular barrier, enters the thoracic duct, passes into the subclavian vein, and finally reaches the general circulation. Once having reached the blood-stream, the staphylococcus rarely grows in it. Most often it localizes in the organs. Depending upon the resistance met with in the organs, and following its affinity, the micro-organism localizes in the bone-marrow, in the endocardium, or in the kidneys."

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[1] Duker: Deutsche med. Wchnschr., 52, 1173, 1926.

[2] Hans, H.: Münch. med. Wchnschr., 71, 1686, 1924.

[3] Wassermann, A. von: München. med. Wchnschr., 69, 596, 1922.

[4] Hofmann, E.: Deutsche med. Wchnschr., 49, 347, 1923.

[5] Saalfeld, E.: Med. Klin., 18, 1527, 1922.

[6] Kleeberg, L.: Klin. Wchnschr., 3, 175, 1924.

[7] Stajano, C., and Hormaeche, E.: An. de Fac. de med. de Univ. de Montevideo, 11, 46, 1926.

[8] Besredka, A.: Local Immunization. Translated from the French by Harry Plotz: The Williams & Wilkins Co., Baltimore, 1927.

Besredka has shown that dressings soaked in a treated culture of staphylococcus and applied to the skin act as a vaccine. Moreover, he found that when an eight- to ten-day broth culture of staphylococcus was filtered, a broth-like liquid was obtained which was non-toxic to animals when injected. The staphylococcus grows sparsely or not at all after reinoculation in this liquid, although other bacteria will grow luxuriantly in it. This substance resists heat and is specific. The inhibitory action of this liquid is superior to the heated culture and reacts only on the staphylococcus.

Besredka states that "there are two substances within the staphylococcus. One a thermolabile virus which is adherent to the body of the bacterium and which may produce serious skin lesions or death of an animal. The other is atoxic, thermostable, and is easily detached from the body of the germ and antagonizes the former substance." Besredka calls this substance the *antivirus*. "Both the virus and the antivirus derived from the staphylococcus are absolutely specific and both possess an elective affinity for the skin." "A protective dose of the staphylococcus filtrate, injected into the peritoneal cavity, is practically without effect." If injected under the skin it has a slight vaccinating effect but the action is less than when it is injected directly into the skin. The greatest degree of immunity is obtained when the entire surface of the skin takes part in the process of vaccination which may be accomplished by applying a dressing soaked in the vaccinating fluid to the entire abdominal surface (in animals). Although but a part of the skin is thus vaccinated, the rest of the cutaneous surface is affected, without the participation of antibodies.

Besredka concludes from his studies that filtered cultures may be of service in medical practice. "Wherever the localization of the infected cells may be—whether it be a furuncle, an osteomyelitis, a phlegmon, lymphangitis, pleural fistula, diseases of the eye, puerperal infection, or even in certain cases of generalized septicemia—the mode of action of the filtrate is the same. When applied by wet dressings to the infected tissues, it produces an influx of leukocytes, leads to the disappearance of the pathogenic agent, and facilitates the elimination of those cellular elements which retard cicatrization. By vaccinating the neighboring healthy cells these filtered cultures succeed in surrounding the focus and so extinguish the inflammatory process." "The specific dressing, with filtered cultures, acts at the same time on the bacteria and on the cells. It stops the multiplication of the former and activates the defensive properties of the latter."

III. SYSTEMIC TREATMENT

Vaccines have long been employed in the treatment of furunculosis. They are of the autogenous and polyvalent varieties. The autogenous vaccines are prepared from cultures made from the patient's furuncle and are useful in about 50 per cent. of the cases to prevent the development of other boils.

A hopeful aspect of furunculosis is the possible relation of the condition to an excess of carbohydrates. The severity of furunculosis in the presence of diabetes is well known, but even when the urine is sugar free, it is possible that a high normal blood-sugar may increase the liability to furunculosis. On the basis of self-experience Pfahler[1] immediately reduces the carbohydrate diet to a minimum on the appearance of a boil. Bieber,[2] who investigated the blood-sugar in furunculosis, has used 2 units of insulin daily for four days, and says that in four days the furuncles disappeared. Stormer[3] reports good results in furunculosis from the use of 20 to 80 units of insulin daily.

The ingestion of beer yeast was thought to exert a favorable influence on furunculosis, but this method of treatment has fallen into disfavor.

In 1925 Bier[4] reported the successful treatment of 28 out of 35 cases of furunculosis by homeopathic doses of sulphur administered internally. He recommended one tablet containing 0.1 mg. of sulphur iodide three times daily, one-half hour before meals.

Oliver[5] gives one capsule containing 3 gr. of bisulphate of quinine three times daily for two days, and then two capsules for two days, three capsules for two days, four capsules for two days, and finally five and six capsules each for two days.

Of considerable interest is the treatment of staphylococcus infections with tin and its compounds. Frouin and Gregoire[1] conclude: (1) That metallic tin and tin oxide were absorbed by the digestive tract; (2) that tin was innocuous to the ingesting animal; (3) that tin had a beneficial effect on staphylococcus septicemia; and (4) that the bactericidal action of tin and its compounds justifies its use for patients with staphylococcus infections.

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[1] Pfahler, G. E.: Atlantic Med. Jour., 28, 586, 1925.

[2] Bieber, J.: Med. Jour. and Rec. (supp.), 119, 144, 1924.

[3] Stormer, A.: Klin. Wchnschr., 4, 477, 1925.

[4] Bier: Quoted by Heulten, Münch. med. Wchnschr., 72, 713, 773, 1925.

[5] Oliver, Edward A.: Personal communication.

Gregoire and Frouin[2] produced in stannoxyl a compound composed essentially of metallic tin and tin oxide. They state that they used it successfully in 50 cases of furunculosis and believe that it has a specific action upon the staphylococcus. Other clinical reports are not lacking. The dose of stannoxyl is 0.5 to 1 gm. (four to eight tablets) daily. Levy[3] praised the action of tin in the form of "hordostan." In the cases of forty children under twelve years of age who were suffering from hordeolum he gave from one-half to one tablet two to three times daily by mouth.

IV. ANESTHESIA

Increase of elimination by laxatives, increase of fluid ingestion, and bodily and local rest are to be advised.

When incision or injection is decided upon in the treatment of furuncles and carbuncles, a choice of anesthetic must be made. Ethyl chloride, recommended by Franke,[4] is useful, but must be properly applied to produce a good anesthesia and to prevent the very marked danger of gangrene. The injection of a local anesthetic is approved by Freeman[5] and Farr[6] but is disapproved by de Takáts[7] and the author. Axhausen[8] uses novocaine before "glow-needle" therapy. Sometimes it is possible to block the sensory nerves supplying the infected area by local anesthesia. For anesthesia of lip and nose furuncles Klinger[9] has injected 1 per cent. novocaine into the supra-orbital nerves. Wilmoth[10] uses hyoscine-morphine anesthesia. Nitrous oxide or ethylene is probably the best.

Griffiths[11] outlines his treatment of carbuncles as follows:

1. *General Treatment.*—(*a*) Measures to increase the patient's resist-

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[1] Frouin, A., and Gregoire, R.: Compt. rend. Acad. d. sc. Par., 164, 794, 1917.

[2] Gregoire, R., and Frouin, A.: Bull. Acad. de méd. Par., 77, 704, 1917.

[3] Levy, S.: Deutsche med. Wchnschr., 52, 1303, 1926.

[4] Franke, F.: Med. Klin., 19, 1549, 1923.

[5] Freeman, L.: Keen's Surgery, Philadelphia, W. B. Saunders Co., 1, 256.

[6] Farr, R. E.: Local Anesthesia, 1923, p. 236, Lea & Febiger.

[7] de Takáts, G.: Personal communication.

[8] Axhausen, G.: Med. Klin., 20, 340, 1924.

[9] Klinger, G.: Zentralbl. f. Chir., 50, 1530, 1923.

[10] Wilmoth, A. D.: Kentucky Med. Jour., 25, 414, 1927.

[11] Griffiths, H. E.: Lancet, 1, 37, 1925.

ance to the spread of infection; (*b*) elimination of toxins; (*c*) induction of sleep.

2. *Local Treatment.*—(*a*) Relief of pain; (*b*) removal of necrotic tissue; (*c*) arrest of infection in surrounding parts; (*d*) epithelization of raw surface after separation of sloughs.

Chiari[1] outlines the following treatment of lip furuncles:

Mild Cases.—(1) Heat; (2) rest; (3) prohibition of speech; (4) fluid nourishment; (5) with the appearance of fluctuation, a small incision with the cautery.

Transitional Cases.—(1) Autogenous blood injections; (2) simple central cauterization; (3) hyperemia; (4) special heat.

Severe Cases.—(1) Autogenous blood injections; (2) hyperemia; (3) splitting thermocautery incision (within the infected area).

Carp[2] studied 153 cases of carbuncles at the Presbyterian Hospital, New York, in an effort to compare the merits of four different methods of treatment, viz.: (1) *x*-Ray irradiation plus accessory therapy; (2) surgery plus accessory therapy; (3) conservative treatment; and (4) blood circuminjection without accessory treatment. Because of the dissimilarity of carbuncles and the lack of a definite scheme of tabulation, it is extremely difficult to compare methods of treatment. He presents the following conclusions for consideration:

1. In large carbuncles, diabetic and non-diabetic, the treatment of choice is radical surgery.

2. In small, superficial carbuncles and in some large carbuncles, including those of the face, *x*-ray therapy as an aid to conservative therapy (poultices, carbolization, etc.) has given good results. If, however, improvement does not occur in from three to four days other measures (surgery, circuminjection of autogenous blood) are indicated.

3. In diabetic carbuncles the prompt establishment of free drainage is essential to prevent spread of the infection. *x*-Ray therapy without surgery is contraindicated.

4. Circuminjection of autogenous blood may be used in selected cases and is a valuable adjunct to the treatment of accessible spreading infections by any other method.

5. There has been no proof in the clinical cases analyzed in this series that *x*-ray therapy alone effected a cure. Reports in the literature seem to confirm this experience.

The writer[3] has collected published reports of a wide variety of therapy of furuncles and carbuncles. As a result of this study the following considerations seem to be justified:

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[1] Chiari, O. M.: Deutsche Ztschr. f. Chir., 194, 247, 1926.

[2] Carp, L.: Ann. Surg., 86, 702, 1927.

[3] Christopher, Frederick: International Abstract of Surgery, May, 1928, pp. 345-355.

Each furuncle and each carbuncle is a problem in itself. There are no inelastic rules governing the treatment of these types of infection. In but few surgical ailments is a like amount of judgment and experience required to make an accurate diagnosis of the type of the lesion, its state of progress, and the most appropriate form of treatment. The high morbidity of furuncles and carbuncles and the mortality of the latter, particularly those on the face, demand the most serious thought and discrimination in the choice of treatment. The surgeon must have a thorough appreciation of the underlying pathology and physiology. He must keep in mind the risk to the patient, the amount of pain, and the duration and expense of the treatment. In our present state of knowledge the safest treatment is that which best brings about localization of the infection, if possible, effective drainage, and rapid healing. Many of the newer methods proposed are well worth study, but have not yet been used in a sufficient number of cases to prove their value.

Surgeons will await with interest further reports on autogenous blood circuminjection and the criteria which govern its use. The administration of tin is so simple that it would doubtless be widely adopted if more recent and more abundant reports of its usefulness were available. The danger of traumatism to necrotizing infections from premature or ill-advised incisions has become a matter of more general knowledge.

"In large carbuncles, diabetic and non-diabetic, the treatment of choice is radical surgery."[1] *Most furuncles are best treated by conservative measures (hot moist dressings, softening ingredients, carbolization, etc.) until they discharge spontaneously or until fluctuation indicates incision and drainage. In certain small carbuncles conservative measures are justifiable for from twenty-four to forty-eight hours. If there is no improvement at the end of that time, surgery is to be advised.*

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[1] Carp, L.: Ann. Surg., 86, 702, 1927.

CHAPTER V

BURNS[1]

BURNS may occur from the effects of hot solids (hot-water bags!), hot air, hot liquids or steam, from exposure to sunlight and to ultraviolet light, and from acids, alkalis, electricity, Roentgen rays, radium, caustic substances of various kinds and irritant gases (Schamberg[2]).

In this country and Germany it is customary to classify burns into three grades according to the depth: First degree, erythema; second degree, vesicle formation, and third degree, partial or complete involvement of the skin or underlying structures. In England and France it is usual to divide burns into the six degrees of Dupuytren's classification, viz.: First degree, superficial congestion; second degree, bleb formation; third degree, destruction of cuticle with exposure of the nerve terminals—the most painful form of burn; fourth degree, the whole thickness of the skin is destroyed; fifth degree, the muscles are encroached upon, and sixth degree, the entire limb is involved.

According to Pack[3] and MacLeod[4] the extent of a burn is more important than the depth. All burns of first degree are fatal if two-thirds of the body surface is involved[5] and all burns of second degree are fatal in adults if one-third of the body surface is involved, and in children if one-seventh is involved.[6] All burns covering one-third of the body surface are extremely serious, if not imminently fatal. All burns involving one-tenth of the body surface should be considered serious (Pack[7]). Berkow's[8] work is useful in the estimation of the extent of surface lesions.

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[1] The subject matter of this chapter is practically the same as that appearing in the author's article on "The Present Status of Burn Therapy," Amer. Jour. Surg., n. s., v, No. 1, 61-65, 1928. What is reprinted is by permission of the American Journal of Surgery, published by P. B. Hoeber, Inc., 76 Fifth Avenue, New York City.

[2] Schamberg, J. F.: Keen's Surgery, Philadelphia, W. B. Saunders Co., 7, 48, 1921.

[3] Pack, G. T.: Prognosis in Burns and Scalds, Amer. Jour. Surg., 40, 59, 1926.

[4] MacLeod, J. M. H.: Quoted by Davidson. Oxford Surgery, 2, 438, 1919.

[5] Miller, S. R.: Approved and Condemned Methods in the Treatment of Burns and Scalds, Internat. Jour. Surg., 30, 423, 1921.

[6] Davidson, E. C.: Personal communication.

[7] Pack, G. T.: Prognosis in Burns and Scalds, Amer. Jour. Surg., 40, 59, 1926.

[8] Berkow, S. G.: Method of Estimating Extensiveness of Lesions Based on Surface Area Proportions, Arch. Surg., 8, 138, 1924.

He concludes that the lower extremities, including the buttocks, comprise 38 per cent. of the body surface; the trunk, including the neck, 38 per cent.; the upper extremities 18 per cent., and the head 6 per cent. The hand is one-quarter of an upper extremity and the arm three-quarters. Of the lower extremity, the foot is one-sixth, the leg one-third, and the thigh one-half.

It would seem highly desirable that in the future burns be classified both by extent and depth, for example, a 30 per cent. second-degree burn, or a 10 per cent. third-degree, or a 25 per cent. second-degree burn. It is to be remembered that other things being equal, burns in children and infants are more serious than in adults. Forty-five per cent. of the deaths from burns occur during the period from birth to the fifth year.[1]

More recent studies have added to our knowledge of the physiology of burns. In extensive burn cases the adrenal glands weigh from three to five times the normal and the epinephrine content is absent or low (Weiskotten[2]). Olbrycht[3] states that the only anatomical changes in severe burns in man and animals are in the adrenals and that the intensity of the hyperemia and ecchymosis and reduction or total loss of chromaffin substance and lipoid in these glands seemed to depend upon the extent of the burned area and the age of the subject, being most pronounced in the young. He says that the adrenals displayed the same type of changes as in anaphylactic shock and peptone intoxication and he ascribes these changes to a toxic action from the decomposition of protein in the burned tissues. Brancati[4] believes death to be due to an anaphylactic shock from the proteins changed by the heat. Robertson and Boyd[5] believe the toxin to consist of primary and secondary proteoses. The interesting work of Greenwald and Eliasberg[6] shows that in rabbits the cause of death may be divided into two stages: (*a*) Initial stage which is due to shock and which is accompanied by high blood-sugar content due to a hyperactivity of the adrenals; and (*b*) the secondary stage which is due to degenerative changes, particularly in the adrenal. From this it would appear that the administration of adrenalin is to be restricted to the second stage and is contraindicated in the primary stage. Theoretically, the use of insulin might seem to be indicated in the primary stage.

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[1] Pack, G. T.: Etiology and Incidence of Thermal Burns, Amer. Jour. Surg., 1, 21, 1926.

[2] Weiskotten, H. C.: Fatal Superficial Burns and the Suprarenals, Jour. Amer. Med. Assoc., 69, 776, 1917.

[3] Olbrycht, J.: Experiments on Pathogenesis of Death from Burns, Rev. de med., 41, 81–115, 1924; abstr. Jour. Amer. Med. Assoc., 83, 1802, 1924.

[4] Brancati, R.: Death from Burns, Policlinico, 31, 233–259, 1924; abstr. Jour. Amer. Med. Assoc., 82, 2089, 1924.

[5] Robertson, B., and Boyd, G.: Toxemia in Severe Superficial Burns in Children, Amer. Jour. Dis. Child., 25, 163, 1923.

[6] Greenwald, H. M., and Eliasberg, H.: Pathogenesis of Death from Burns, Amer. Jour. Med. Sci., 171, 682, 1926.

Underhill, Carrington, Kapsinow, and Pack[1] studied the concentration of the blood in burned cases by means of hemoglobin estimations. They found that in extensive superficial burns the blood becomes highly concentrated, and they believe that the degree of blood concentration is an index of the patient's general condition. Davidson and Mathew[2] explain this concentration of the blood in burn cases by assuming an early increased permeability of the capillaries. Pack,[3] basing his belief on his work with Underhill,[4] feels that a 40 per cent. increase in hemoglobin, if maintained over a period, is incompatible with life. The extreme concentration of the blood requires the copious administration of fluids by all avenues.

Davidson[5, 6] showed a lowering of the whole blood and plasma chlorides which is proportionate to the amount of tissue devitalized and which is present as long as sloughs are present. On this account Davidson suggested sodium chloride administration.

According to Novak,[7] ulceration of the gastro-intestinal tract is an uncommon complication of extensive cutaneous burns, occurring probably in about 5 per cent. of the fatal cases. Rouchese,[8] in reporting a fatal hemorrhage from a duodenal ulcer fourteen days after a third-degree burn, says he has seen ulcer but once in 348 burned persons.

TREATMENT OF EXTENSIVE BURNS

Primary Shock.—The primary shock in extensive burns is similar to any surgical shock. There is blunted sensibility, cold moist skin, subnormal rectal temperature, irregular sighing respirations, rapid

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[1] Underhill, Carrington, Kapsinow, and Pack: Arch. Int. Med., 32, 31, 1923.

[2] Davidson, E. C., and Mathew, C. W.: Plasma Proteins in Cutaneous Burns, Arch. Surg., 15, 265, 1927.

[3] Pack, G. T.: Prognosis in Burns and Scalds, Amer. Jour. Surg., 40, 59, 1926.

[4] Underhill, Carrington, Kapsinow, and Pack: Arch. Int. Med., 32, 31, 1923.

[5] Davidson, E. C.: Prevention of Toxemia in Burns; Treatment by Tannic Acid Solution, Amer. Jour. Surg., 40, 114, 1926.

[6] Davidson, E. C.: Sodium Chloride Metabolism in Cutaneous Burns and Its Possible Significance for Rational Therapy, Arch. Surg., 13, 262, 1926.

[7] Novak, Ed.: Gastro-intestinal Ulceration Following Cutaneous Burns, Amer. Jour. Med. Sci., 169, 119, 1925.

[8] Rouchese, F.: Riforma Med., 40, 753, 1924; abstr. Jour. Amer. Med. Assoc., 83, 1038, 1924.

"thready" pulse, and very low blood-pressure. Morphine is given in dosage adequate to control pain. External heat is applied and fluids are pushed, using hypodermoclysis or proctoclysis if necessary. Great care is to be exercised in the removal of the clothing. It is very shocking and often may be better deferred until there is some recovery from shock. Placing the patient in a warm bath often facilitates the removal.

Toxic Shock.—In twenty-four to forty-eight hours, or as late as the fourteenth day,[1] the signs of the toxic protein absorption become evident. The temperature is elevated, the pulse is rapid, the patient action may be drowsy or delirious, there is vomiting, and death may quickly ensue. Long before this stage measures should have been instituted in the wound itself, which tend to make the toxin innocuous or remove it altogether. Should, however, there be evidence of toxemia this is to be energetically combated.

Systemic Treatment of Toxemia.—(*a*) 4000 to 5000 c.c. of fluids, preferably sodium chloride solutions, are given by hypodermoclysis, protoclysis, and by infusion. Sodium bicarbonate and water are given by mouth. This alleviates the blood concentration and the low chloride content. Should fluid accumulate later in the tissues, magnesium sulphate will assist in its removal.

(*b*) Epinephrine may be indicated to remedy adrenal deficiency.

(*c*) Blood transfusions. Riehl[2] first advocated blood transfusions in 1925, and in 1927[3] he reported the use of blood transfusions combined with the other "customary" methods in 32 severely burned cases: 10 cases, which most probably would have been fatal, recovered. In 11 cases the blood transfusions prolonged life, and in 2 cases they were of no value. Davidson[4] transfuses on admission any patient with a possible lethal burn. This is done before the onset of shock. If shock develops the transfusion is repeated in less than twenty-four hours. In 1923 Robertson and Boyd[5, 6] proposed the rather heroic exsanguination-transfusion in which the patient is thoroughly bled before the transfusion.

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[1] Moorhead, J. J., and Killian, J. A.: Metabolism in Burns, Bull. New York Acad. Med., 3, 401, 1927.

[2] Riehl, G.: Treatment of Severe Burns by Blood Transfusion, Wien. klin. Wchnschr., 38, 833, 1925; abstr. Jour. Amer. Med. Assoc., 85, 860, 1925.

[3] Riehl, G.: Zur Behandlung schwerer Verbrennungen mit Bluttransfusion, Arch. f. Dermat. u. Syph., 153, 41, 1927.

[4] Davidson, E. C.: Personal communication.

[5] Robertson, L. B., and Boyd, G.: Toxemia in Severe Superficial Burns in Children, Amer. Jour. Dis. Child., 25, 163, 1923.

[6] Robertson, L. B.: Exsanguination-transfusion; New Therapeutic Measurement for Severe Toxemias, Arch. Surg., 9, 1, 1924.

Local Treatment of Toxemia.—In 1925 Davidson[1] made his epoch-making contribution to the therapy of burns. This worker, in searching for a chemical which would fix the toxic substances in the burned tissue, hit upon tannic acid. The burned area should at the earliest moment be covered with gauze saturated in a 2½ per cent. freshly prepared aqueous solution of tannic acid (Fig. 43). In localities where burns may be expected, it is very useful to place in clean dry bottles such quantities of tannic acid as will make up a 2½ per cent. solution when the bottle is filled with water. (This is a routine on the Great Northern Railway, Dr. R. C. Webb, Chief Surgeon.) The gauze is ~~kept moist~~ with this solution or the skin is directly sprayed with it for twenty-four hours.

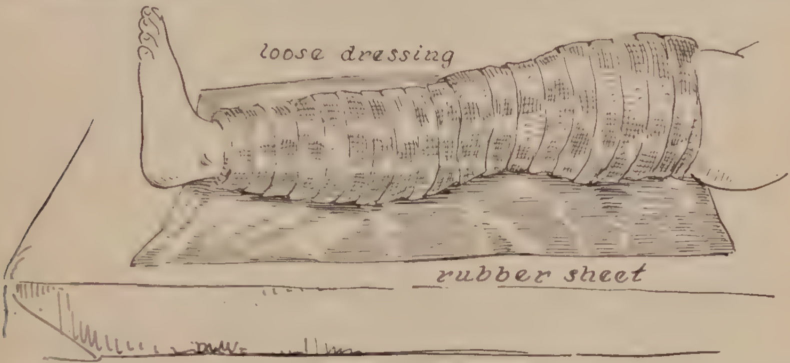

Fig. 43.—Tannic acid treatment of burns. The burned extremity is loosely wrapped in sterile gauze and placed upon a waterproof sheet. The gauze is then thoroughly saturated with a 2½ per cent. aqueous solution of tannic acid.

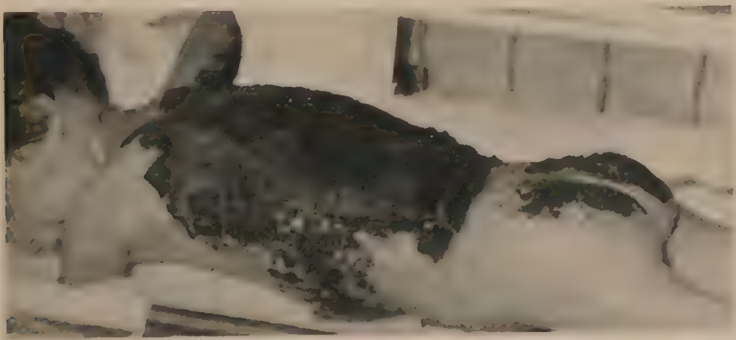

Fig. 44.—Tannic acid treatment of burns, showing condition of the burned area after treatment with tannic acid. (Children's Memorial Hospital, Chicago. Courtesy of Dr. A. H. Montgomery.)

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[1] Davidson, E. C.: Tannic Acid in Treatment of Burns, Surg., Gynec., and Obst., 41, 202, 1925.

or more until the burned skin is thoroughly tanned. At this stage it is generally deep brown or black, and is dry (Figs. 44–46). After this time the burn is treated in the open air by a cradle (Fig. 47). Warm irrigations of boric solution or normal salt solution are useful

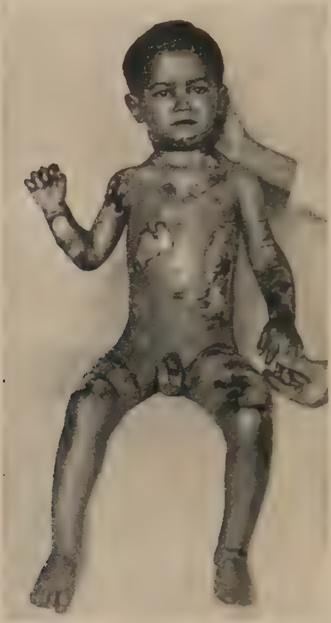

Fig. 45.—Tannic acid treatment of burns. (Children's Memorial Hospital, Chicago. Courtesy of Dr. A. H. Montgomery.)

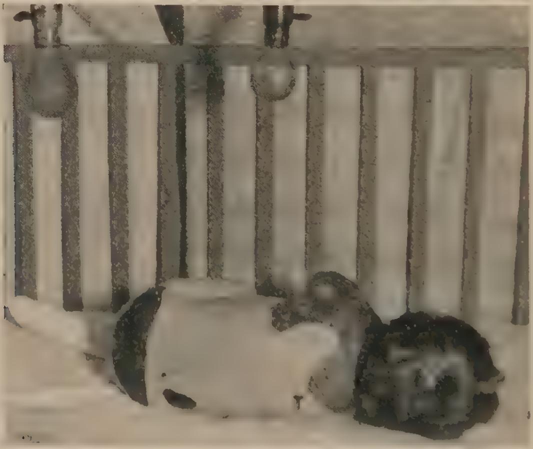

Fig. 46.—Tannic acid treatment of burns. The burned areas have been thoroughly tanned, and the child is lying in the open air in an enclosed crib kept warm by electric lights. (Children's Memorial Hospital, Chicago. Courtesy of Dr. A. H. Montgomery.)

to remove any discharge or loosened sloughs. The bed-linen and drapes must be sterile. An electric-light bulb is placed inside the cradle to insure warmth (about 100° F.) and dryness. Hosmer[1] believes a wire immobilizing cage to be useful in extremity burns.

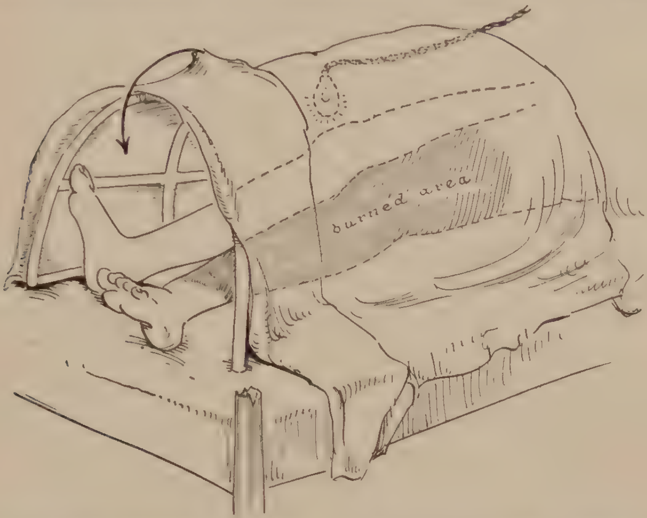

Fig. 47.—Tannic acid treatment of burns. After the burned area has been tanned it is exposed to the open air under an electric-light-heated tent.

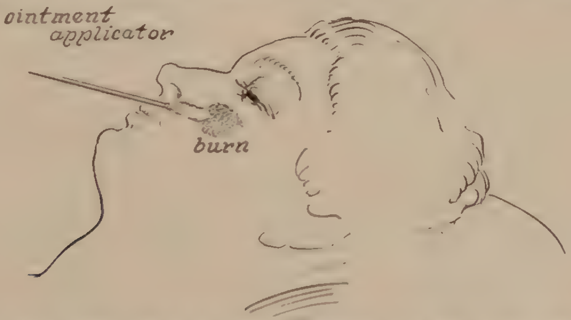

Fig. 48.—Tannic acid treatment of burns. Application of 5 per cent. tannic acid ointment to burns of the face.

For *face burns* the tannic acid is employed in the form of a 5 per cent. ointment (Fig. 48). The tannic acid treatment has received hearty endorsement by Bancroft and Rogers,[2] by Beck and

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[1] Hosmer, A. J.: Immobilizing Cage for Treatment of Burns and Skin Grafts, Amer. Jour. Surg., 3, 23, 1927.

[2] Bancroft, F. W., and Rogers, C. S.: Treatment of Cutaneous Burns, Ann. Surg., 84, 1, 1926.

Powers,[1] and by Cabot.[2] On the face a 5 per cent. tannic acid ointment is used. The availability of this method is evidenced by the paper of Shen[3] in the China Medical Journal. Shen found an infusion of tea to be nearly as effective as the tannic acid solution and gives the following directions for its preparation. One gm. of leaves in 100 c.c. of boiling water is considered as a 1 per cent. infusion. The infusion, to be effective for protein precipitation, must be 8 per cent. A fifteen-minute 8 per cent. infusion is prepared and sterilized by boiling. This tea is dark red in color and bitter to taste.

2ʒ tea
8 by wt
3ʒiii
H_2O

Hypertonic solutions have been advised, on the theory of withdrawing the toxins into the dressing. Wilson[4] champions the "detoxication" treatment of burns by employing dressings which provoke osmosis toward the surface. He uses sodium chloride and glycerin and later saturated boric solution, changing the dressings frequently. This writer also employs a solution of standard ensol solution, 1 part; 10 per cent. saline solution, 2 parts, and water, 2 parts. Robertson and Boyd[5] employ a saturated solution of soda bicarbonate. Ten per cent. soda bicarbonate delivered by Carrel tubes is used by Goldblatt.[6] Waterhouse[7] uses aluminum acetate. Davidson,[8] however, warns against the use of wet dressings because of the danger of tissue dehydration.

Débridement of the entire burned tissue has been advised on the theory that toxic absorption cannot take place once its source is removed. Willis[9] believes that débridement relieves the toxemia, reduces the pain, and hastens local healing. Pagenstecher[10] débrides the entire area and dresses the wound with an alcoholic solution of picric acid. Recently Mackenzie[11] also has recommended extensive débridement.

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[1] Beck, C. S., and Powers, J. H.: Burns Treated with Tannic Acid, Ann. Surg., 84, 19, 1926.

[2] Cabot's case, 121, 83, Boston Med. and Surg. Jour., 194, 848, 1926.

[3] Shen, J. K.: Tea in Treatment of Burns, China Med. Jour., 41, 150, 1927.

[4] Wilson, W. R.: Detoxication in Treatment of Burns, Brit. Med. Jour., 1, 54, 1927.

[5] Robertson, B., and Boyd, G.: Toxemia in Severe Superficial Burns in Children, Amer. Jour. Dis. Child., 25, 163, 1923.

[6] Goldblatt, D.: Study of Burns, Their Classification and Treatment, Ann. Surg., 85, 490, 1927.

[7] Waterhouse, H. F.: An Address on Certain Subjects of Interest, Brit. Med. Jour., 2, 61, 1910.

[8] Davidson, E. C.: Prevention of Toxemia in Burns; Treatment by Tannic Acid Solution, Amer. Jour. Surg., 40, 114, 1926.

[9] Willis, A. M.: Value of Débridement in Treatment of Burns, Jour. Amer. Med. Assoc., 84, 655, 1925.

[10] Pagenstecher, G. A.: Treatment of Burns, Jour. Amer. Med. Assoc., 84, 1917, 1925.

[11] Mackenzie, D.: Treatment of Burns, Brit. Med. Jour., 1, 421, 1927.

Débridement is rather drastic, causes greater scarring, and since the advent of the tannic acid treatment is but rarely to be used.

The Treatment of the Wound.—It is to be remembered that a burn is a wound and that the usual antiseptic and aseptic precautions which obtain in the treatment of all wounds apply to burns. All irrigations, applications, or dressings must be sterile. Strong antiseptics are to be avoided and irrigations with boric acid or merely normal saline solution are employed. Moorhead and Killian[1] make the somewhat startling statement that no antiseptic is of proved value in wounds and accordingly in burns. They believe antiseptics to be insufficient in infected wounds. Picric acid greatly lessens pain and, while considered safe in a 1 per cent. solution, it must be used with caution because of the danger of poisoning. An ointment containing butyn and picric acid is very soothing, but the writer has seen dermatitis follow its use. Blisters are to be opened and drained at the side, preferably through the intact skin margin, after suitable surface sterilization. The epidermis of the blister is not to be cut away unless there is pus under it.

The administration of tetanus antitoxin may be considered after first ascertaining the patient's non-susceptibility to horse-serum. Goldblatt[2] reported 3 cases of tetanus among 83 cases of burns. Davidson,[3] however, believes that many recorded cases of tetanus have been convulsions due to edema of the brain or thrombosis.

Numerous applications have been devised whose primary purpose is to allay pain. Carron oil (equal parts of lime-water and linseed oil) is a very efficient thing for relief of pain, but is generally stale and contaminated. Tomb[4] uses a liniment made from a solution of chlorinated lime. Ambrine is a French preparation of secret formula, but consisting essentially of paraffin and oil of amber. It has enjoyed considerable popularity in burn therapy. Sherman[5] treated 3000 cases by the paraffin method up to 1918 and still (1928) believes it very efficient.[6] The patient is free from pain after the first twenty-four hours in most cases. There is more rapid epithelization in surface burns under paraffin, and the scar formation is thought to be less.[1] Trueblood[2] emphasizes that paraffin should never be used in a wound harboring necrotic tissue. The wound should first be débrided and sterilized

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[1] Moorhead, J. J., and Killian, J. A.: Metabolism in Burns, Bull. New York Acad. Med., 3, 401, 1927.

[2] Goldblatt, D.: Study of Burns, Their Classification and Treatment, Ann. Surg., 85, 490, 1927.

[3] Davidson, E. C.: Personal communication.

[4] Tomb, J. W.: Linimentum Calcis Chlorinatæ in Treatment of Burns, Brit. Med. Jour., 1, 711, 1924.

[5] Sherman, W. O'N.: The Paraffin-wax or Closed Method of Treatment of Burns, Surg., Gynec., and Obst., 26, 450, 1918.

[6] Sherman, W. O'N.: Personal communication.

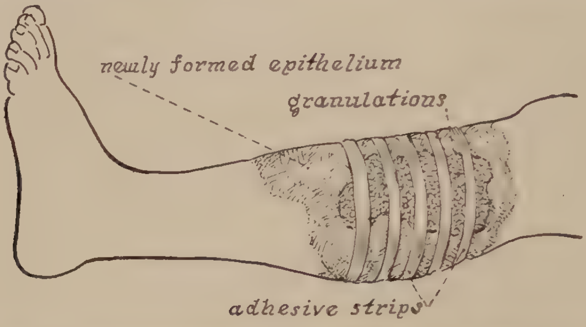

Fig. 49.—Method of accelerating epithelization by bridging granulation tissue with adhesive strips.

and also, according to Sherman, dried. The paraffin is then applied by spray or brush. The burn is dressed every day. Unguents containing phenol have use in allaying pain. Recently Fist[3] recommended

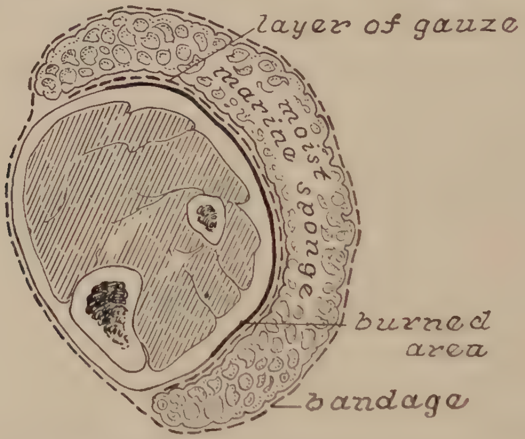

Fig. 50.—The use of a moist marine sponge to effect pressure upon the granulating area left by a burn.

a combination of gelatin and formaldehyde which forms a rubber-like substance on burns. "Parresined Lace Mesh Surgical Dressing" (Abbott Laboratories) has been found useful. When the wound is cleanly ~~granulating, adhesive, vaseline gauze~~ strips or rubber tissue strips across the granulations will facilitate epithelization (Fig. 49). Moist boric dressings may be used in conjunction with the strips. Koch[1] believes pressure, particularly that obtained by marine sponges, to be useful (Fig. 50). Rubber tissue is to be kept between fingers to prevent adhesions and consequent "webbing." To large areas, particularly where contractures are to be feared as in the antetracheal, axillary, and popliteal spaces, Thiersch grafts are to be applied with the extremity extended and splinted. The value of extension as a prophylactic measure against contracture is questioned by Blair.[2] Moorhead and Killian apply to the wound what they term "wound fertilizer." This is a mixture of 1 dram of scarlet-red ointment to 1 ounce of sterile olive oil.

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[1] Pierce, S.: Surgical Clinics of North America, 3, 841, 1923.

[2] Trueblood, D. V., Paraffin Treatment for Burns and Denuded Areas, Northwest Med., 25, 255, May, 1926.

[3] Fist, H. S.: Dressing for Burns, Jour. Amer. Med. Assoc., 88, 1483, 1927.

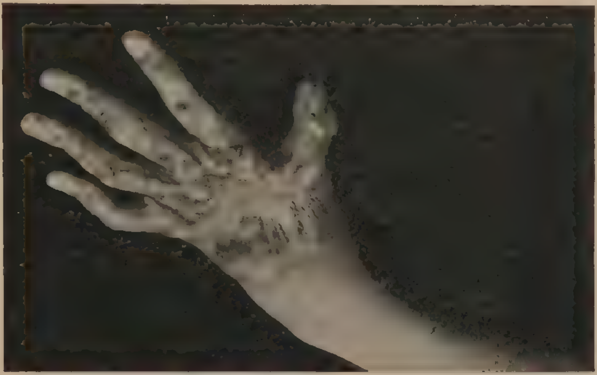

Fig. 51.—Scar following burn of the hand.

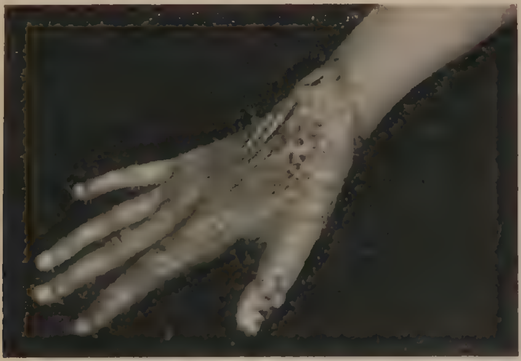

Fig. 52.—Scar following burn of the hand. Keloid formation.

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[1] Koch, S. L.: Personal communication.

[2] Blair, V. P.: Quoted by Koch, personal communication.

The correction of burn scars is a matter of plastic surgery (Figs. 51–57). Of interest in this correction are the papers of Blair[1] and McCurdy.[2] Johnson[3] has found carcinoma in the scar tissue following burns. In lime burns of the eye the gross particles should be removed

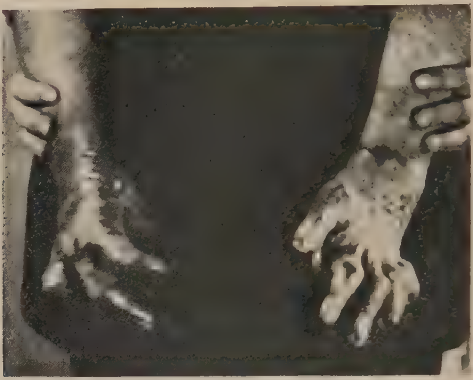

Fig. 53.—Scars of burns on hands. (Surgical Dispensary, Northwestern University Medical School.)

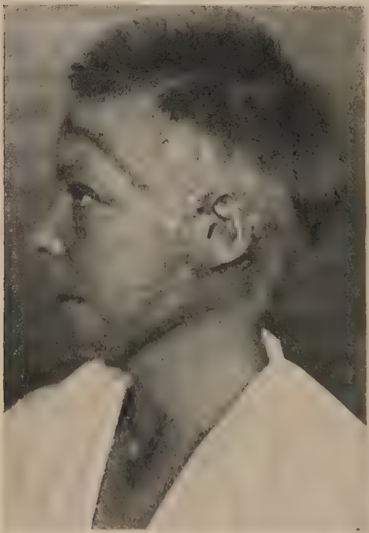

Fig. 54.—Scars following burns of face and neck. Note retraction of chin and limitation to extension of the head.

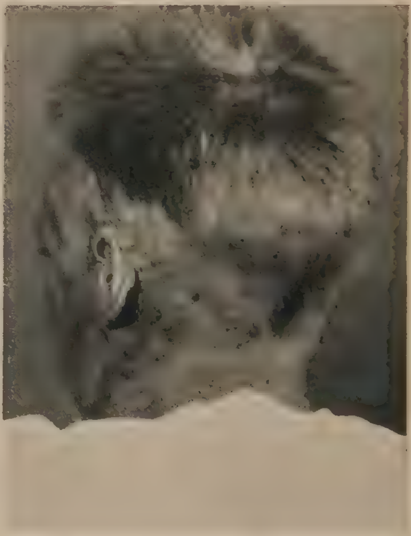

Fig. 55.—Burn scars. Note loss of substance of ear.

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[1] Blair, V. P.: Southern Med. Jour., 16, 522, 1923.

[2] McCurdy, S. L.: Correction of Burn Scar Deformity, by Z-Plastic Method, Jour. Bone and Joint Surg., 6, 683, 1924.

[3] Johnson, F. M.: Development of Carcinoma in Scar Tissue Following Burns. Ann. Surg., 83, 165, 1926.

by manipulation and douche of 3 per cent. soda bicarbonate or boric acid solution. Olive oil may then be instilled. For the resulting corneal

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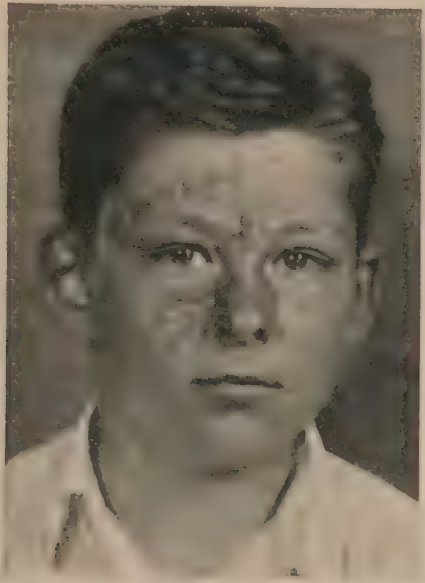

Fig. 56.—Burn scars with tendency to keloid formation.

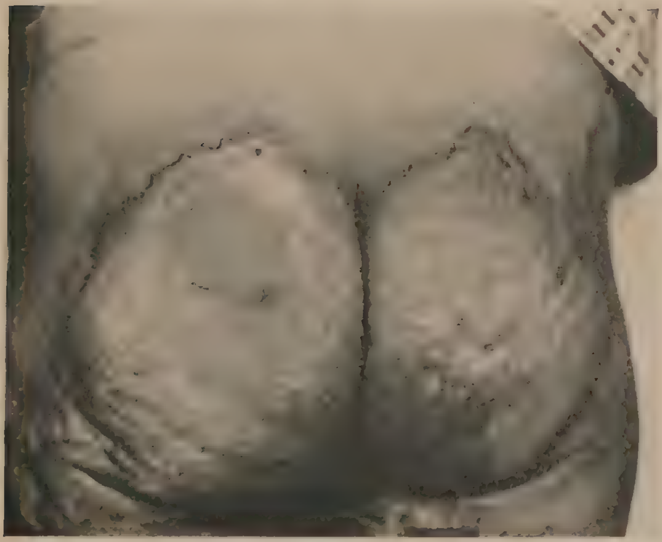

Fig. 57.—Keloid following burns of the buttocks. (Courtesy of Dr. Francis E. Senear.)

opacity, cocainize the eye and wash with a freshly prepared 10 per cent. solution of neutral ammonium tartrate.

Davidson[1] has made an experimental study of the treatment of acid and alkali burns. He concluded that ". . . the results obtained in the treatment of experimentally produced alkali and acid burns were decidedly better when the caustic agent was removed by dilution with water than when rendered inert by neutralization. When treatment by neutralization is employed, it should only be employed after the maximum amount of the caustic has been removed by thorough washing."

Summary.—Extensive burns (that is, of 10 per cent. or more of the body surface) are first treated for shock by morphine, external heat, vigorous administration of fluids, and possibly by blood transfusion. As early as possible, gauze saturated with 2½ per cent. tannic acid solution is applied to the entire burned area and kept moist with this solution for twenty-four hours or more until the burned skin is thoroughly tanned. The burned area is then treated by the open-air method under a heated cradle, supplemented by warm boric or soda irrigations. Fluids are pushed, and epinephrine and sodium chloride may be exhibited. Repeated blood transfusions occasionally are indicated. When all sloughs have disappeared and the wound is cleanly granulating, adhesive or rubber tissue strips are applied and scarlet-red preparations may be used to accelerate epithelization. Skin-grafting occasionally is advisable.

For small burns (5 per cent. of the body surface or less) the application of soothing ointments containing phenol or picric acid, and gauze dressings is the best treatment.

[1] Davidson, E. C.: Ann. Surg., 85, 481, April, 1927.

CHAPTER VI

INJURIES BY ELECTRICITY

WADSWORTH[1] has classified injuries caused by electricity into four types: (1) From currents applied for therapeutic purposes; (2) from industrial currents; (3) from lightning; (4) from radiant discharges—as *x*-ray burns. It is to be remembered that the dry skin is a very good insulator, but that the moist skin offers but little defense against the passage of electrical currents. The majority of accidents come to those who are employed about electrical appliances, but any wet hand which comes in contact with a socket of the ordinary 110-volt lighting current may encounter a deadly current. "Fortunately, the first effect of the current is to cause violent muscular contractions; at times these throw the man some distance, breaking the contact, thus saving his life" (Wadsworth). Burns may frequently occur at the point of contact. These may vary in intensity from erythema to actual charring. The likelihood of the person having received the whole charge is less if the skin is intact after the injury. Jellinek[2] has given definite indications for surgical intervention in cases of electrical injuries. He notes that the vitality of the tissues surrounding an electric burn for a considerable distance is difficult to judge before several weeks have passed. The electric current leaves an invisible line of demarcation. There is a marked tendency of the affected vessels to embolism and to sudden and profuse hemorrhages. The indications for surgical intervention are: (1) Profuse hemorrhages, which seldom occur before the third or fourth week. (2) A lumbar puncture should be the first aid rendered at the site of the accident when the victim is unconscious or apparently dead, or upon a conscious patient whenever there are symptoms of cerebral edema or of increased cerebral pressure. Amputations are only indicated on account of serious systemic disturbances. Nerves and tendons may have to be sutured. In another paper Jellinek[3] reports the case of a man whose life was doubtless saved by timely lumbar puncture. This patient came in contact with a current of 5000 volts and collapsed, apparently dead, but was re-

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[1] Wadsworth, William S.: DaCosta's Modern Surgery, 9th ed., p. 1477.

[2] Jellinek, S.: Wien. klin. Wchnschr., 41, 766, May 31, 1928.

[3] Jellinek, S.: Wien. klin. Wchnschr., 41, 622, May 3, 1928.

suscitated by artificial respiration. Delirium, trismus, and opisthotonus followed. Lumbar puncture was done with great difficulty, owing to the violent convulsions of the patient, and 25 c.c. of bloody fluid was obtained. The pulse improved and an hour later the patient was fully conscious. Mouzon[1] says that operation is particularly dangerous after electrical injury because the current produces parietal thromboses, which may result in embolism, and causes a fragility of the vessel walls which favors the occurrence of secondary hemorrhage.

According to Jellinek[2] both high- and low-tension currents have the same lethal effect, and death is not produced by amperage or voltage, but by a combination of several physiochemical and physiological phenomena. Alternating currents are more dangerous than direct.

Deaths from lightning are more frequent in the rural districts than in the cities. According to figures of the Surgeon General of the Public Health Service, Dr. H. S. Cumming (given to Dr. Keen), there were 461 fatal cases in the registration area in 1923—possibly 541 in the whole United States. In a storm animals are more dangerous than an equal amount of metal, because of the enormous surface of the damp hair. Trees with a corky bark which offer an enormous surface become more dangerous when such bark becomes damp than smooth-barked trees (Wadsworth).

The following are the *rules for resuscitation* by the *Prone Pressure Method* as approved by the American Gas Association, American Red Cross, American Telephone and Telegraph Company, Bethlehem Steel Corporation, National Electric Light Association, National Safety Council, United States Army (Office of the Surgeon General, War Department), United States Bureau of Mines, United States Bureau of Standards, United States Navy (Bureau of Medicine and Surgery), and United States Public Health Service.[3]

"**The Prone Pressure Method of Artificial Respiration. Follow These Instructions Even if the Patient Appears Dead.**—As soon as possible feel with your fingers in the patient's mouth and throat and remove any foreign body (tobacco, false teeth, etc.). If the mouth is tight shut, pay no more attention to it until later. Do not stop to loosen the patient's clothing, but immediately begin actual resuscitation. Every moment of delay is serious. Proceed as follows:

"1. Lay the patient on his belly, one arm extended directly overhead, the other arm bent at elbow and with the face turned outward and resting on hand or forearm so that the nose and mouth are free for breathing (Fig. 58).

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[1] Mouzon, J.: Presse méd., Paris, 36, 834, 1928.

[2] Jellinek, S.: Quoted by Delkeskamp, G., Bruns' Beitr. z. klin. Chir., 141, 515, 1927.

[3] These rules were furnished through the courtesy of Dr. C. K. Drinker of the Department of Physiology, Harvard University.

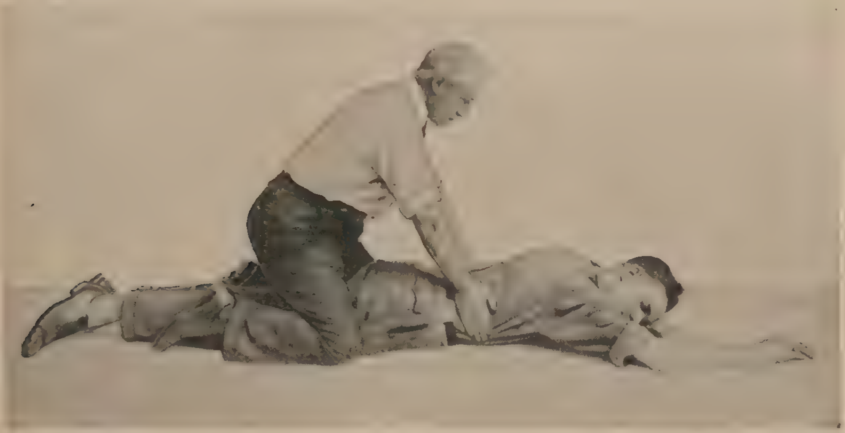

Fig. 58.—Artificial respiration. Position in which patient should always be placed and kept until conscious; also first position for operator starting artificial respiration. (Pamphlet issued by Consolidated Gas Co. of New York.)

"2. Kneel, straddling the patient's thighs, with your knees placed at such a distance from the hip bones as will allow you to assume the position shown in Fig. 58.

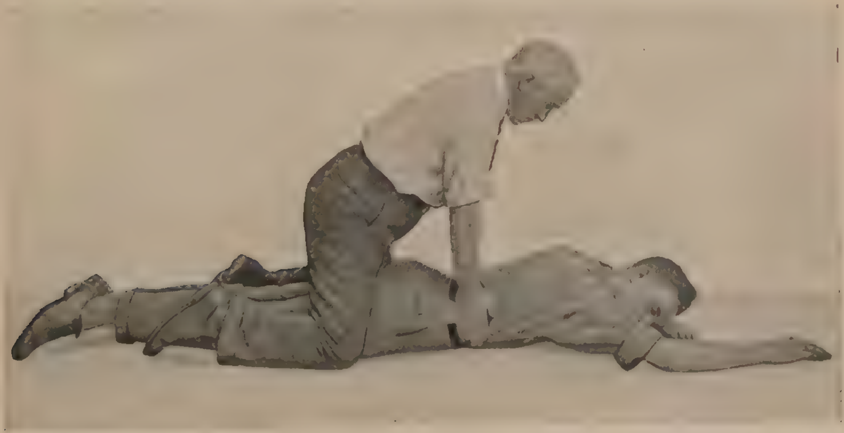

Fig. 59.—Second position of operator giving artificial respiration. (Pamphlet issued by Consolidated Gas Co. of New York.)

"Place the palms of the hands on the small of the back with fingers resting on the ribs, the little finger just touching the lowest rib, with the thumb and fingers in a natural position, and the tips of the fingers just out of sight (Fig. 58).

"3. With arms held straight, swing forward slowly so that the weight of your body is gradually brought to bear upon the patient. The shoulder should be directly over the heel of the hand at the end of the forward swing (Fig. 59). Do not bend your elbows. This operation should take about two seconds.

"4. Now immediately swing backward so as to completely remove the pressure (Fig. 60).

"5. After two seconds, swing forward again. Thus repeat deliberately twelve to fifteen times a minute the double movement of compression and release, a complete respiration in four or five seconds.

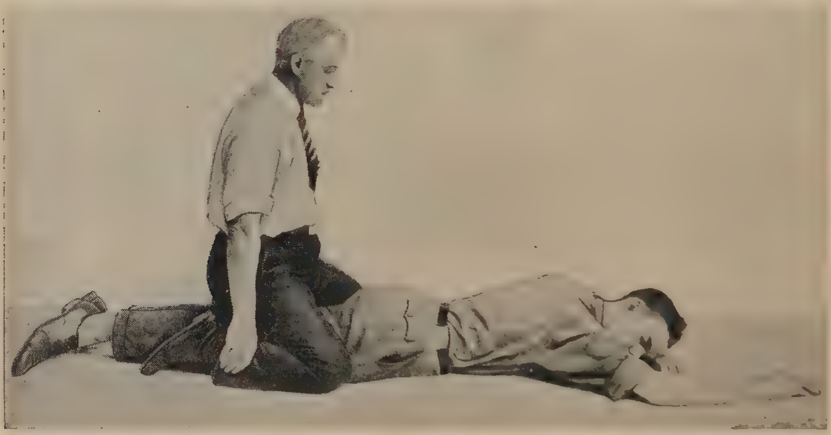

Fig. 60.—Third position of operator giving artificial respiration. (Pamphlet issued by the Consolidated Gas Co. of New York.)

"6. Continue artificial respiration without interruption until natural breathing is restored, if necessary, four hours or longer, or until a physician declares the patient is dead.

"7. As soon as this artificial respiration has been started and while it is being continued, an assistant should loosen any tight clothing about the patient's neck, chest or waist. *Keep the patient warm.* Do not give any liquids whatever by mouth until the patient is fully conscious.

"8. To avoid strain on the heart when the patient revives, he should be kept lying down and not allowed to stand or sit up. If the doctor has not arrived by the time the patient has revived, he should be given some stimulant, such as one teaspoonful of aromatic spirits of ammonia in a small glass of water, or a hot drink of coffee or tea, etc. The patient should be kept warm.

"9. Resuscitation should be carried on at the nearest possible point to where the patient received his injuries. He should not be moved from this point until he is breathing normally of his own volition and then moved only in a lying position. Should it be necessary, due to extreme weather conditions, etc., to move the patient before he is breathing normally, resuscitation should be carried on during the time that he is being moved.

"10. A brief return of natural respiration is not a certain indication for stopping the resuscitation. Not infrequently the patient, after a temporary recovery of respiration, stops breathing again. The patient must be watched and, if natural breathing stops, artificial respiration should be resumed at once.

"11. In carrying out resuscitation it may be necessary to change the operator. This change must be made without losing the rhythm of respiration. By this procedure no confusion results at the time of change of operator and a regular rhythm is kept up."

"General Points to be Observed in All Cases Requiring Resuscitation.—1. *Take Care of the Patient.*—An unconscious person becomes cold very rapidly, and chilling means a further strain on a vitality already weakened. Experience has shown that the cold to which the victims of gassing, electric shock, or drowning are often carelessly exposed is probably the most important cause of pneumonia, and this disease is the most dangerous after-effect of all these accidents. As far as possible keep the patient covered while artificial respiration is being given. Use hot pads, hot-water bottles, or hot bricks, but remember that an unconscious man has no way of telling you when he is being burned.

"If it should be necessary to move the patient, keep him lying down, and do not permit him to exert himself.

"2. *Medicines and Medical Help.*—Never give an unconscious man anything to drink. It may choke him. Medical science knows no drug which of itself will start breathing in a patient whose breathing has ceased.

"Continue artificial respiration for at least four hours in all cases. Breathing has returned after eight hours in a case of electric shock, but in such instances the patient will give some evidence of recovery which will cause continued effort on the part of his rescuers. Medical men have sometimes been mistaken in declaring patients dead and employees of public utility companies have succeeded with resuscitation after such declarations. Therefore, the ordinary and general tests for death should not be accepted, and any doctor should make several very careful and final examinations and be sure specific evidence is present, before pronouncing the patient dead.

"**Electric Shock.**—*Breaking the Contact.*—The victim must be freed from the contact as promptly as possible. Use a dry stick, dry rope, dry coat, or other non-conductor. Use of your own hands without protection is dangerous and may add another victim to the accident.

"*The Action of the Electric Current.*—In electric shock the current may pass through the breathing center at the base of the brain and cause this center to stop sending out the nervous impulses which act upon the muscles responsible for breathing. As a consequence, breathing stops abruptly. If the shock has not been severe, after a time the breathing center recovers and resumes the vitally necessary duty of sending impulses to the muscles of breathing. In such cases, the immediate use of the prone pressure method substitutes this artificial breathing for the natural respiration of the patient. As has been pointed out, the current may so paralyze the breathing center as to require eight hours for recovery, and the prone method must be used unceasingly throughout this entire time. If, during prolonged artificial respiration, the body can be placed on a door or other flat surface so that the head and chest are 6 or 8 inches lower than the feet, the flow of blood to the heart is promoted and a better chance given for recovery.

"Victims of electric shock of this sort are unconscious, but in them the heart and blood circulation continue. Their treatment demands artificial respiration with the greatest possible promptness. The method for giving this and the general measures for the care of such patients have been given.

"If the electric current affects the heart it produces a condition called fibrillation in which the heart resembles a bag of quivering jelly instead of the regular pumping organ which maintains life. Under these circumstances the heart suddenly ceases to pump blood. Many cases of electric shock escape this heart effect and even an experienced examiner requires time to assure himself it has occurred. Consequently it is the duty of those first reaching the shocked person to give artificial respiration by the prone method at once and to allow time and medical examination to determine whether the heart has stopped.

"*Use of Inhalation in Electric Shock.*—Shocked patients who have resumed breathing often suffer later periods of failure of breathing. They must be watched closely for hours after the accident. The use of the inhalation treatment should render such failures of breathing less likely to occur.

"Whenever possible obtain the assistance of a gas company emergency crew to aid you with inhalation in these cases, but remember that the measure which saves life is the prone pressure method of artificial respiration."

Treatment of Burns.—Any suitable sterile dressing is suitable for the first-aid treatment of burns. Sterile vaseline, picric acid, solution of sodium bicarbonate, or even a clean dry cloth is useful. The writer sees no contraindication to the tannic acid treatment.

CHAPTER VII

CIRCULATORY DISTURBANCES AND GANGRENE

1. **Varicose veins** have been defined as those having a permanent dilatation due to changes in their walls (Matas). Varices (varicose veins) are of four types[1]: (1) The isolated saccular varix; (2) the tortuous varix; (3) the solitary, dilated, and hypertrophied but otherwise normal piece of vein interposed between the varices, and (4) fine cutaneous dilatations. In addition to the changes in the walls themselves, varicose veins are characterized by having incompetent valves. Varicose veins occur in people whose occupations require them to be long hours on their feet, as motormen, policemen, etc. There are, however, exceptions to this generalization. Varicose veins of the lower extremity are apparent when the patient is standing and disappear when the patient is lying down. The internal saphenous vein and its branches generally are oftenest affected. Gangier[2] believes that the tonicity of the venous walls is dependent upon certain hormones secreted by the endocrine glands. Impaired secretion of the genital glands or the hypophysis seems to occur frequently with varicosities. Nicholson[3] studied 112 cases of varicose veins and found the number fairly equally divided between males and females; that pregnancy usually is not a cause for varices, though in certain persons it may have an important secondary influence; that 69 per cent. of 102 patients developed varicose veins between the ages of eighteen and thirty; that the opening of the saphenous veins is always protected by two or more pairs of valves; that the treatment may often be difficult and unsatisfactory; and that great care should be taken in selecting cases for operation. Berntsen[4] stresses the importance of heredity and believes that varices occur more frequently in women than in men. A patient presenting himself for examination for varicose veins should be subjected to tests for the competency of the valves (Trendelenburg test) (see Fig. 66). With the patient lying prone, the leg is extended straight upward so that the blood may flow out of the leg. He is then

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[1] Berntsen, A.: Acta chirurg. Scand., 1927, 62, 61.

[2] Gangier: La Presse médicale, 34, 1442, November 17, 1926.

[3] Nicholson, B. B.: Arch. Surg., 15, 351, September, 1927.

[4] Berntsen, A.: Acta chirurg. Scand., 1927, 62, 61.

directed quickly to stand upright and if the valves at the saphenous opening and below be incompetent, it will be noticed that the blood immediately regurgitates into the veins of the dependent extremity. If, while this test is made, pressure is applied at the saphenous opening and the veins do not fill with blood, it may be assumed that the incompetency of the valves is at that level. If, however, they fill with blood while there is pressure at the saphenous opening, one may conclude that there is incompetency of the valves of the internal veins of the leg and their communication with the external veins. If the return circulation of the leg is stopped after an elastic bandaging of the entire leg, one may suspect a deep femoral thrombosis—a certain contraindication excision of the superficial veins.

Varicose veins occasionally may cause the patient considerable pain or a sensation of heaviness. On the other hand, very large varicosities may be absolutely symptomless. A moderate traumatism very frequently will rupture a varicose vein and alarming hemorrhage will occur. Such hemorrhages, of course, are readily controlled by direct pressure on the bleeding point and by elevation of the extremity. The writer has seen a case of an old blind man, a derelict in the New York slums, who upon arrival of the ambulance was found dead surrounded by a pool of blood from a ruptured varicose vein. The simplest type of first aid would have been far more valuable than the frantic effort at procuring a doctor. In another case a ruptured vein of the scrotum (varicocele) nearly caused a fatal hemorrhage.

Varicose veins of the lower extremities frequently are the site of phlebitis which requires the appropriate treatment of rest and elevation. These cases seem to recover much more rapidly with hot fomentations than with the application of cold. A most distressing complication of varicose veins is the occurrence of *varicose ulcer* (*ulcer cruris*). No out-patient department or dispensary is free from a dismal parade of these victims of chronic leg ulcer (Figs. 61-65). They may be very severe and disabling. The basic cause of varicose ulcer is the stagnation of fluid in the tissues which results from varicose veins. The local resistance of the tissues to infection or trauma becomes diminished. McPheeters'[1] diagram (Fig. 66) indicates the mechanics of the stasis. The immediate cause of the ulcer may be a small trauma or an embolus from an infected tooth or tonsil. The differential diagnosis of varicose ulcer is given by McPheeters (*loc. cit.*) as follows:

A. Pete

2. **Varicose ulcers** are by far the most common ulcerating condition of the lower extremities and are of all sizes, shapes, and conditions.

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[1] McPheeters, H. O.: Surg., Gynec., and Obst., October, 1928.

Associated with the ulcer there is usually a well-marked area of inflammatory reaction, which at times will spread for several inches beyond the open ulcer. The ulcer as well as the surrounding tissues

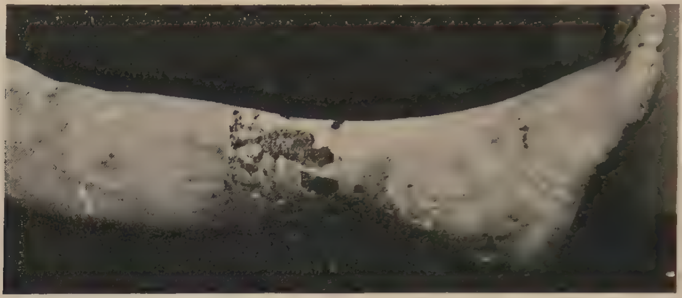

Fig. 61.—Varicose ulcer. (Surgical Dispensary, Northwestern University Medical School. Courtesy of Dr. G. de Takáts.)

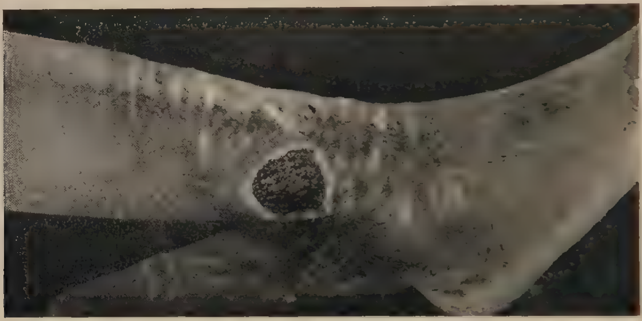

Fig. 62 —Varicose ulcer. (Surgical Dispensary, Northwestern University Medical School. Courtesy of Dr. G. de Takáts.)

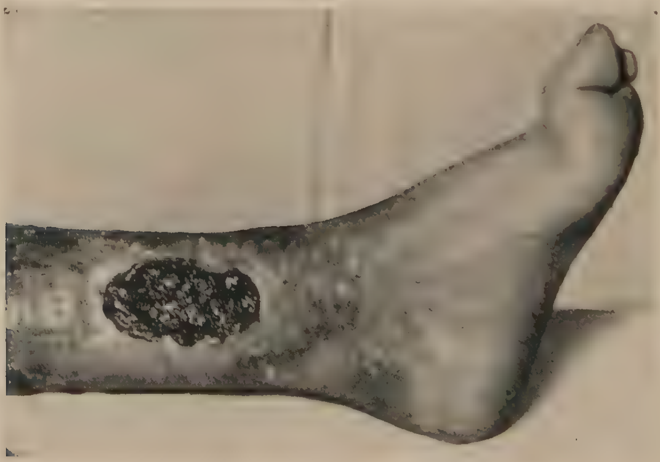

Fig. 63.—Varicose ulcer.

may be very tender. The edges are usually sloping in appearance and the base is ordinarily covered with large, coarse granulations, and a grayish exudate. The discharge may be very profuse. As already stated the dilated varicose veins with their reflux flow and accompanying congestion are accepted as being the cause of the varicose ulcer. One can nearly always find these large venous channels about the ulcerating area. Sometimes the veins lead directly into and under the ulcer and in these cases a very positive diagnosis can be made.

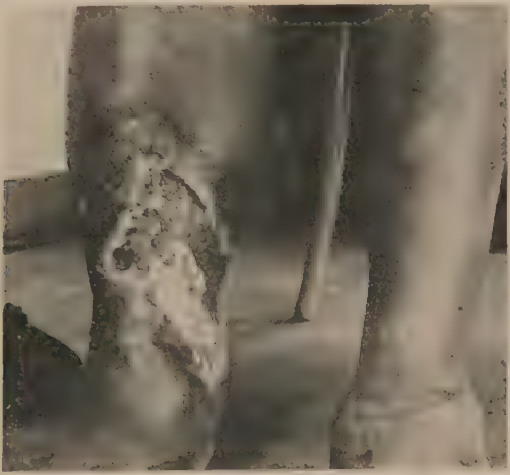

Fig. 64.—Varicose ulcer with lymphangitis. (Surgical Dispensary, Northwestern University Medical School. Courtesy of Dr. G. de Takáts.)

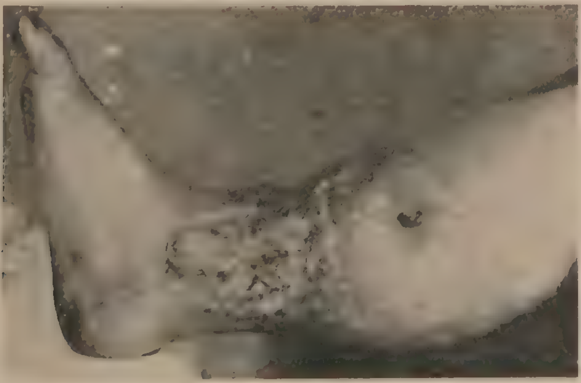

Fig. 65.—Varicose ulcer with lymphangitis. (Surgical Dispensary, Northwestern University Medical School. Courtesy of Dr. G. de Takáts.)

3. The **syphilitic ulcer** usually has punched out, sharply defined edges, which at times are raised. It is ordinarily deeper than ulcers

arising from other causes. The base is dark red and has large granulations, which may be unusually large in the larger ulcers and may bleed very readily. Much serum exudes from the surface, but this does not give the impression of being pus. Luetic ulcers may assume any shape or condition. In addition to the clinical appearance, a positive Wassermann is present and often a history of the original infection is obtained.

4. The **tuberculous ulcer** is uncommon on the lower extremities. The edges are usually undermined. Some authors state it has a tendency to progress with an irregular border outline giving the impression at times of a half circle, but this is not a tuberculous characteristic. The base is seldom red and granulating as in the luetic ulcer, but more frequently is covered with a grayish necrotic exudate. It is thought that the tuberculous ulcer is always secondary to tuberculosis elsewhere. An active tuberculosis would, of course, be a definite diagnostic sign.

5. The **rodent** or **malignant ulcers** are infrequent on the lower extremities, although common elsewhere. They are found in older patients and do not have the local inflammatory reaction which is seen with varicose ulcers. There would be no varicose veins except as a coincidence and there would be no response to the usual treatment. With a negative Wassermann, no symptoms or signs of tuberculosis, and with no response to the usual ulcer treatment, a biopsy should be made to confirm the diagnosis.

6. **Trophic ulcers** can usually be diagnosed without difficulty after consideration of the clinical history of the case. Tabes

7. The **actinomycotic ulcer** starts as a nodule, subsequently breaking down, leaving a necrotic base with scattered yellowish nodules. This type of ulcer is very rare and is seldom seen except in hide-handlers, etc. The diagnosis would be suspected when cure had resisted all treatment. Curettings should be made from the ulcer base with examinations for the ray fungus.

Frequently the treatment which these patients receive is directed solely at efforts to heal the ulcer without proper attention to the underlying cause, namely, the pressure from the distended varicose veins above the ulcer. The varicose veins should be treated primarily and the ulcer secondarily.

Non-operative Treatment of Varicose Ulcer.—In the measures to be described in the following paragraphs for the treatment of varicose ulcer, it must be constantly borne in mind that *the most important part of the treatment of varicose ulcer is the preliminary or coincident treatment* *of the varicose veins.* The treatment of varicose veins will be described in the following section.

Practically all varicose ulcers may be healed by the simple but generally impracticable expedient of putting the patient to bed with the leg elevated upon a pillow and the use of continuous, warm boric fomentations. After the infection has been eradicated and the ulcer has a clean granulating base, the healing may be expedited by skin-grafting. If no treatment, however, has been directed toward the varicose veins the ulcer is liable to promptly recur when the patient is ambulatory again. For patients who are necessarily ambulatory by far the best treatment is the application of an *Unna paste boot.* The composition of Unna's paste is as follows:

Zinc oxide	1000 gm.
Gelatin	600 gm.
Glycerin	1400 c.c.
Distilled water	2200 c.c.

de Takáts[1] believes that the following formula gives the most satisfaction:

Zinc oxide	100 gm.
Gelatin	200 gm.
Water	300 c.c.
Glycerin	400 c.c.

This material is cut up in slices and warmed on a water-bath before being used.

The technic of applying the Unna paste boot is as follows: The leg is thoroughly cleansed with soap and water, especially the ulcer itself, and is thoroughly dried. Granulations if present are curetted off, the ulcer is painted with 3 per cent. iodine or mercurochrome (2 per cent.), and a sterile dressing is applied. Devane[2] applies a rubber sponge to the ulcer so that it extends a half inch all around the edges. The Unna paste, which has been melted in a water-bath and cooled to a temperature which will be tolerated by the skin, is then painted on the leg with a large brush, from just below the knee to the ankle. While it is still moist, the leg is enveloped in a very smoothly and carefully applied single layer of gauze bandage, taking care not to reverse the bandage because of danger from wrinkles. A second coat of the melted Unna paste is then applied and over this a second layer of gauze bandage. Frequently these two layers will suffice, but where more support is required a third layer may be applied. Cannon and Lowenfish[1] apply the bandages already soaked in the warm solution of Unna's gelatin glue. These writers do not advise cutting a window in the cast for access to the dressing because it removes the uniform support of the parts. Thirty-four of their cases of varicose ulcer were cured by the combined treatment of local intravenous injections of sodium solution and the wearing of an Unna cast. Lowenfeld[2] says that in cases where other methods of healing the ulcer have failed, the epithelial implantations of Braun are of value. A superficial cutaneous area is taken from a sound place of the patient's thigh or from another person's and cut up into very small particles while in physiological salt solution. Oblique deep canals are bored with a sound into several places of the ulcerous surface and one of the cutaneous particles is cut into each of them, so that it disappears entirely below the surface of the ulcer. According to Braun, rapid growth of epithelium ensues from these epithelial implantations over the ulcer surface and leads to the local epithelization of the granulation surface and, by confluence of the newly formed cutaneous islands, to the cicatrization of wounds in large defects which otherwise would heal badly. Credé

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[1] de Takáts, Geza: Jour. Amer. Med. Assoc., 92, 775, March 9, 1929.

[2] Devane, James: The Lancet, 213, 864, October 22, 1927.

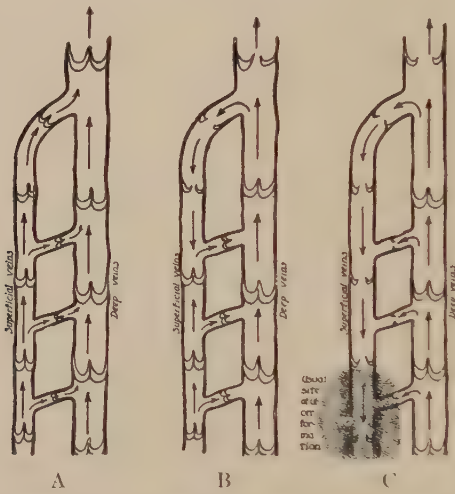

Fig. 66.—A, Nominal flow in superficial and deep veins. B, Beginning reflex in superficial veins. C, Complete loss of valve function in superficial and communicating veins. (McPheeters, H. O., Surg., Gynec., and Obst., October, 1928.)

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[1] Cannon, A. B., and Lowenfish, E. P.: Arch. Derm. and Syph., 15, 647, June, 1927.

[2] Lowenfeld, W.: Wien. klin. Wchnschr., 39, 1278, October, 1926.

ointment (metallic silver) has been useful and Pfab[1] has praised silver chloride salve.

More recently Sicard, de Takáts, and others have had very successful results in the treatment of varicose veins and ulcers by a method which suits itself admirably to out-patient and office practice. The technic of de Takáts[2] is as follows:

"The patient is examined in the standing position and the most peripheral dilatation is selected for injection. This segment is isolated between the second and third fingers of the left hand and the patient's leg is brought to a horizontal position, the skin rubbed with alcohol, and a fine 24-gage needle on a 10-c.c. Luer syringe is inserted into the vein, which is immediately aspirated for blood (Fig. 67). Only in case of free flow of blood is the injection permissible. From 5 to 10 c.c. of a 50 per cent. dextrose solution is injected slowly. The needle is kept in the vein and the compression of the vein above and below is maintained for another two minutes. After the needle has been withdrawn a cotton plug is pressed against the vein and is kept in place under pressure by strips of adhesive plaster (Fig. 68). This should not be removed for at least forty-eight hours following the injection. Usually another injection is given at the same time from 3 to 4 cm. higher. The injections are repeated biweekly. An elastic bandage is advisable during the entire course of treatment."

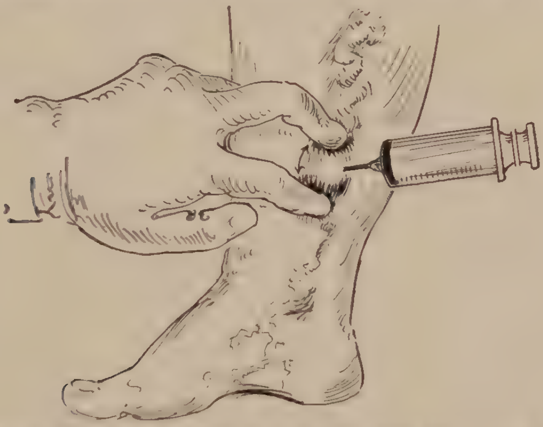

Fig. 67.—Technic of injecting a varicose vein. Second and third fingers of the left hand isolate a segment of the vein. A fine needle is inserted and the injection is made slowly after a successful aspiration for blood. (de Takáts, G., Jour. Amer. Med. Assoc., March 9, 1929.)

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[1] Pfab, B.: Mitt. a. d. Grenzgeb. d. Med. u. Chir., 38, 575, 1925; abstr. Jour. Amer. Med. Assoc., 85, 1680, November 2, 1925.

[2] de Takáts, Geza: Jour. Amer. Med. Assoc., 92, 775, March 9, 1929.

The hypertonic glucose solution causes sufficient injury to the intima of the vein, so that when pressure is applied directly afterward very often adherence of the opposite walls of the vein may be effected and complete obliteration brought about. This treatment may be repeated at intervals in different areas of the vein and may be accompanied to advantage by ligation of the veins of the thigh. Objection to this procedure has been raised on the score that the glucose solution might occasion the formation of thrombi which, in turn, might become dangerous emboli. In the hands of de Takáts this has never occurred, and, moreover, embolism and thrombosis have occurred with unpleasant frequency after the conventional operative treatment of varicose veins.

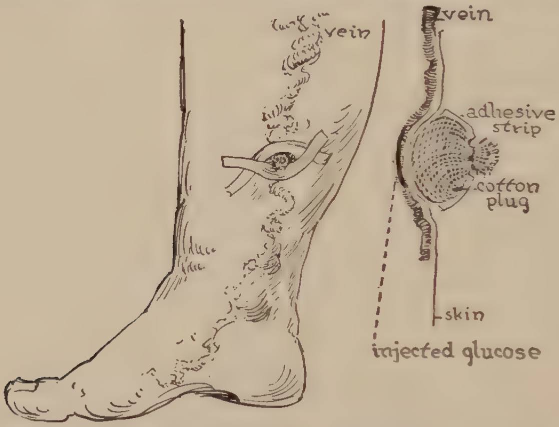

Fig. 68.—The vein is compressed after the injection by a gauze or cotton plug. This compression should be maintained for at least forty-eight hours. (de Takáts, G., Jour. Amer. Med. Assoc., March 9, 1929.)

McPheeters'[1] method of treating varicose ulcer is as follows:

"(1) Inject and sclerose all veins as fast as they can be found. (2) Apply silver nitrate locally, the strength of the solution depending upon the type of granulations present. (3) Cut a good grade of rubber bath-sponge so as to cover 1 inch beyond the edge of the ulcer. (4) Cover the ulcer with gauze, fluffed for better absorption. (5) Apply the cut rubber-sponge over the ulcer. (6) Cover all with two layers of glazed cotton wadding, which is impervious to the discharge and helps keep the bandage clean. (7) Bandage the leg with a good grade of cotton elastic bandage, similar to the 'Ace,' and preferably 4 inches in width. This is put on from knee to toes and as tightly as it can be wrapped. (8) Change the dressings every two or three days as needed for comfort and care of the discharge. (9) Continue the rubber-sponge pressure until the ulcer has completely healed. (10) At the proper time judicious use of skin-grafting will very materially shorten the period of healing. This, however, should not be done until after careful and complete sclerosing of all the offending veins and complete elimination of all the lymphangitis and extensive tissue infection about the ulcer have been effected. The ulcer bed should be carefully prepared as for any skin-graft. (11) In all cases, as soon as the ulcers have healed, put on an Unna cast for continued support. This is *most* essential in cases in which skin-grafts have been made and must be applied before the patient leaves the bed. Change this cast every two weeks at first and then every three or four weeks. In all extensive cases this must be continued for a long time either by casts, bandage, or the elastic and rubber stockings. In some cases the patient needs this support the rest of his life in order to avoid a recurrence."

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[1] McPheeters, H. O.: Surg., Gynec., and Obst., October, 1928, p. 469.

Vischer[1] has given us certain suggestions in regard to the injection treatment of varicose veins. The veins should be as free of blood as is possible during the injection, and, accordingly, are stretched or the lower limb is elevated. The injection must be strictly intravenous and after it has been accomplished a light pressure pad is applied to the skin at the site of the injection for two minutes. The following solutions may be used: Perchloride of mercury, 1 to 3 c.c. of a 1 to 2 per cent. solution; sodium salicylate, 6 c.c. of 20 per cent., 4 c.c. of 30 per cent., 2 c.c. of 40 per cent.; sodium chloride, 5 c.c. of 20 per cent.; glucose, 5 or 10 c.c. of 50 per cent. solution.

Forestier[2] uses 20, 30, and 40 per cent. sodium salicylate, or red mercuric iodide 1 cgm. in 1 c.c. of distilled water, or a solution of .04 gm. of quinine hydrochloride, and .02 gm. of urethane in 3 c.c. of distilled water. This author says that sclerosis of as much as 20 cm. of the vein may be obtained at each injection and a number of injections may be given at one time. Meisen[3] has treated 500 patients with varicose veins by 2224 injections and has had only fourteen recurrences. Moszkowicz[4] injects a 50 to 60 per cent. chemically pure glucose and combines it with ligation of the vein. The ligation is at the highest point of the dilated vein and usually at the upper third of the thigh. However, ligation as high as the level of the opening of the vena saphena into the femoralis is avoided whenever possible in order to keep the patient ambulant. Borcherds[5] reports a case of syphilis with varicose

[1] Vischer, A. L.: The Lancet, 212, 223, January 29, 1927.

[2] Forestier, J.: Jour. Amer. Med. Assoc., 1928, 90, 1932.

[3] Meisen, V.: Acta chirurg. Scand., 1927, 62, 17.

[4] Moszkowicz, L.: Zentralbl. f. Chir., 1927, 54, 1732.

[5] Borcherds, W. M.: Brit. Med. Jour., 1927, i, 375.

veins of the leg in which he cured the varicosities with injections of salvarsan.

D'Allaines and Roseau[1] describe their experiences over two years of the combined treatment of varicose veins by sclerosing injections and ligations above the puncture. The vein is clamped and injected and then ligatures are placed above and below the injection site, which is then resected. These authors used 15 to 25 c.c. of a 30 per cent. salicylate solution. They believe that their results are superior to saphenectomy. Cannon and Lowenfish inject the veins about once a week or whenever the Unna casts are changed. The injections may be made in a single vein in several locations, but usually not closer than 3 inches. As many as fourteen injections have been made at one sitting. The solution which these authors employ is:

Sodium salicylate	1.8 gm.
Procaine hydrochloride	0.05 c.c.
Distilled water q. s.	6.00 c.c.

McPheeters (*loc. cit.*) believes that varicose veins are obliterated far better by the injection treatment than by operation. He warns, however, that the treatment of varicose veins by the injection method should not be attempted by those who are not aware of the complications, . . . but adds that the mortality rate following the injection treatment of varicose veins is much less than with the operative treatment. McPheeters and Rice[2] were able to find only 7 deaths, although reports of some 53,000 cases treated by the injection treatment are on record. This gives a mortality of 0.0024 per cent. Olson[3] reports a case where death occurred ten days after the injection. A thrombus was found in the right ventricle at autopsy.

The Operative Treatment of Varicose Veins.—de Takáts (*loc. cit.*) advises radical excision of varicose veins in the cases with fully developed tortuous masses, with varicosities on the thigh and in the popliteal space, and with a positive Trendelenburg sign.

The operative treatment of varicose veins includes ligations and excision of the long trunks. These operations may very satisfactorily be carried out under local anesthesia. The great saphenous vein is ligated at its highest palpable point. The excision of large venous trunks is generally brought about through longitudinal incisions directly over these trunks. The veins are marked on the skin with silver nitrate or indelible pencil before operation. The employment of multiple incisions, each 3 to 5 inches in length, is probably more suitable than the use of extremely long incisions. The Mayo dissector is a long instrument with a small rounded eyelet at a right angle to the end. Through a small incision the vein is doubly ligated and cut between the ligatures. One end of the vein is then threaded through the eyelet of the Mayo dissector. This is then forced subcutaneously along the path of the vein for a distance of 3 or 4 inches from the first incision. The second incision is then made and the vein ligated at that point. While this method obviates the necessity of making a long incision, it has the rather marked disadvantage of tearing off the collateral branches of the veins so removed. The dissector of Wayne Babcock, which has an olivary tip, is inserted in the vein to a considerable distance; the vein is tied and removed by inversion. After operation the patients are kept in bed for sixteen to twenty-one days (de Takáts).

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[1] D'Allaines, F., and Roseau, H.: La Presse médicale, 35, 25, June 29, 1927.

[2] McPheeters, H. O., and Rice, C. O.: Jour. Amer. Med. Assoc., 91, 1090.

[3] Olson, O. A.: Jour. Amer. Med. Assoc., 89, 692, August 27, 1927.

According to Vaughan and Burnham[1] in "cases where the deep veins are chiefly involved, it is unnecessary to remove the superficial veins. Good results may be obtained if the points of communication (usually from three to six) between the deep and superficial veins are searched for and ligated. These points are easily found, as they are indicated by the points of greatest venous distention and tortuosity. A special test for these points is made with a ring about 2 inches in diameter. This ring is pressed against the leg over the suspected veins, and if the deep veins are at fault, the veins included in the ring will be seen to fill when the patient stands erect. This point is marked, and at operation an incision is made down to the muscle in front of the group of dilated veins. The deep fascia is raised until the connecting branch is seen and ligated. In the same manner all the connections between the deep and superficial veins may be obliterated. This operation may be performed under local anesthesia."

In his interesting article on varicose veins Nicholson[2] says that "a method of eliminating scar formation as far as possible is that of obliterating the lumen of the varix with a continuous silk suture applied subcutaneously." Tanner and Field[3] advise operation of varicose veins if there be pain on standing, edema, eczema, or ulceration of the skin. Phlebitis or ulceration should be remedied before operation.

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[1] Vaughan, J. C., and Burnham, A. C.: Text-book of Minor Surgery, Lea & Febiger, Philadelphia and New York, 1922, p. 404.

[2] Nicholson, B.: Arch. Surg., 51, 351, September, 1927.

[3] Tanner, E. K., and Field, W. H.: Surgical Clinics of North America, 7, 1103, August, 1927.

8. **Aneurysms.**—The only aneurysms which may be included in the domain of minor surgery are those small ones of the extremities which follow wounds or subcutaneous rupture of the small arteries. Foote,[1] in describing these small aneurysms of the hand or wrist which follow puncture wounds, says that the tumors are small, smooth, elastic, compressible, and pulsating. "They can be mistaken for some tumor overlying a normal vessel. Thus a ganglion of the wrist may lie on the radial artery and transmit the pulsation from the vessel. . . . A careful examination will differentiate this transmitted pulsation from a true expansile pulsation." Ligation of the vessel proximal and distal to the aneurysm is indicated.

9. **Thrombosis and Thrombophlebitis.**—Thrombosis has been described by Buerger as a plug formation in a vessel which may bring about practically a complete closure of the vessel lumen. Thrombophlebitis is the condition where infection has been superimposed upon thrombus formation. Bain[2] classifies phlebitis with or without thrombus formation as follows: (1) Recurrent phlebitis of obscure origin, possibly of a gouty nature. (2) Syphilitic phlebitis. (3) Phlebitis associated with a septic wound. (4) Phlebitis following an infectious disease, and (5) intramuscular phlebitis. In thrombophlebitis the patient may suffer from fever and chills in addition to the pain and edema of the extremity which characterize thrombosis alone. The white blood-count is elevated. The treatment of these conditions is rest and elevation of the extremity. In cases of thrombophlebitis hot fomentations may be employed, in addition, to advantage. The period of rest required is variable. Many writers believe that several months' rest is necessary. Others feel that after the subsidence of pain the presence of swelling is no contraindication to restricted use of the limb. Bain (*loc. cit.*) says that if the disease is confined to a superficial vein, convalescence may be complete after four to six weeks, but if a larger vein is involved recovery may require several months. The dangers of massage of an extremity affected by thrombosis or thrombophlebitis are well known. Ill-advised manipulations of the affected veins have been known to break off thrombi and cause them to float freely in the blood-stream and become pulmonary emboli. Cases have been reported where instant death has occurred.

10. **Thrombo-angiitis obliterans** (**Buerger**) is an obliterating disease of the arteries. This disease is accompanied by pains in the soles of the feet, by intermittent claudication (severe pains

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[1] Foote, E. M.: Minor Surgery, D. Appleton & Company, 1912, p. 448.

[2] Bain, W.: Lancet, 1927, 212, 701.

in the calves of the leg induced by a small amount of exercise, and disappearing with rest), coldness and numbness of the feet, redness of the toes, and final disappearance of the pulses. Brooks and Jostes,[1] following a series of experiments with the "thermocouple" needle, believe that valuable information as to the presence or absence of arterial disease may be obtained by the study (by means of the thermocouple) of the temperature changes in the tissues resulting from the alternate obstruction and release of the arterial circulation. The temperature of the distal tissues will fall if the circulation of the blood is obstructed but will rise immediately in the case of normal tissues after the tourniquet has been removed. In cases where the arteries are obstructed by disease, the fall of temperature will continue for two to seven minutes after the removal of the tourniquet. Singleton[2] made studies of the injection of sodium iodide into the arteries (after the method suggested and used by Brooks) and following the injections with *x*-ray examinations. He had good and bad results and came to the following conclusions: (1) Roentgenological examination after intra-arterial injection of sodium iodide accurately reveals the condition of the blood-vessels. Such injection is apparently harmless when there is a good capillary circulation and a free return of the blood into the general circulation. The method is apparently safe. (2) In aneurysms of the extremities, both arterial and arteriovenous, valuable information is gained in regard to the blood-vessels entering and leaving the aneurysms and the collateral circulation, which may be of great assistance in determining the method of treatment. (3) In spontaneous gangrene resulting from venous or arterial obstruction, the method is not safe and probably should not be used. It is contraindicated in moist gangrene with venous obstruction and also in arteriosclerosis because of the narrowing in the arterioles and capillaries. In thrombo-angiitis obliterans, the capillaries are usually much more normal, and there is better collateral circulation; therefore, in this condition, the method should not be harmful. Swelling is usually absent. The prophylactic treatment of this condition is the avoidance of prolonged standing, tight shoes, and of exposure to cold (Buerger). The most useful treatment is the postural. This consists of alternating elevation and depression of the extremity at three- to five-minute intervals for twelve or more hours during the day. The alternations in blood-pressure and the crushing of the vessels have been known to benefit this ailment. Injections of Ringer's solution intravenously have been advocated. Amputation is not infrequently necessary, although early recognition may prevent gangrene.

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[1] Brooks, Barney, and Jostes, Fred A.: Arch. Surg., 9, 485, November, 1924.

[2] Singleton, A. O.: Arch. Surg., 16, 1232, June, 1928.

11. **Arteriosclerosis** is a loss of elasticity in the arteries and may be accompanied by an occlusive thrombosis. In cases where gangrene develops, amputation will be necessary. Ligation of the popliteal artery and vein may be tried.[1]

12. **Raynaud's disease** is a vasomotor neurosis which occurs in young adults and is marked by cold, capillary congestion (cyanosis), and eventually gangrene without vascular occlusion. Raynaud's disease may be related to psychic exertion, trauma, or exposure to cold. The disease which is symmetrical is characterized by tingling pain, intermittent course, anesthesia, first whiteness and then blueness, and generally involves the fingers. To date there has been no satisfactory treatment for this ailment. However, the remarkable success obtained in Ronzini's[2] case suggests that in every form of spontaneous gangrene, galvanization of the dorsolumbar vertebral column and of the affected parts, as well as Roentgen therapy, should be applied for the relief of pain. It is always advisable, even in the absence of a positive Wassermann and of syphilitic antecedents, to try antiluetic treatment.

The writer has thought the following classifications from Brown and Henderson[3] to be of value in differentiating the various arterial diseases.

TENTATIVE CLINICAL CLASSIFICATION OF ARTERIAL VASCULAR DISEASES

I. Functional or Vasomotor Types:
    (*A*) Local Distribution:
        1. Vasoconstricting types:
            (*a*) Multiple phase color reactions: Raynaud's disease.
            (*b*) One phase color reaction: acrocyanosis, dead finger, local syncope.
        2. Vasodilating types:
            (*a*) Erythromelalgia.
    (*B*) General Distribution:
        1. Vasoconstricting types:
            (*a*) Primary or essential hypertension, early stages.
        2. Vasodilating types:
            (*a*) Primary or essential hypotension.

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[1] Morton, John J.: The New England Jour. Med., 199, 607, September 27, 1928.

[2] Ronzini, Mario: Il Policlinico (pract. sect., 34, 1695), November 21, 1927.

[3] Brown, George E., and Henderson, Melvin S.: Jour. Bone and Joint Surg , 9, 613, October, 1927.

II. Organic Types:
- (*A*) Local Distribution:
    1. Arteriosclerosis, with or without thrombosis; diabetic gangrene.
    2. Thrombo-angiitis obliterans.
    3. Simple thrombosis or embolism.
    4. Arteritis of known infectious origin (rheumatic, syphilitic).
    5. Aneurysm with or without thrombosis.
- (*B*) General Distribution:
    1. Arteriosclerosis, primary.
    2. Arteriosclerosis, secondary to hypertension.

13. **Erythromelalgia and Scleroderma.**—Erythromelalgia is an ailment characterized by pain, redness, swelling of the feet, and hyperesthesia. The arterial pulsation is present. Scleroderma has been described as "a disease of the skin in which thickened, hard, rigid, and pigmented patches occur" (Dorland).

14. **Diabetic Gangrene.**—Buerger believes that this condition more properly should be called arteriosclerotic gangrene with diabetes. The prognosis is not unfavorable if appropriate treatment of the diabetes be instituted. Care must be taken for the prevention of infection, and postural treatment be given for the arteriosclerosis. While insulin has robbed diabetes of much of its distressing surgical complications, it cannot be expected to aid much in limiting gangrene.[1] Paizis[2] claims excellent results from the use of diathermy.

15. **Embolic and Thrombotic Gangrene.**—Emboli in the arterial blood-stream may occur as a complication of certain infectious diseases and cause gangrene of the area supplied by the occluded vessels. It has occurred in cases of pneumonia where the prognosis is grave. It may occur as a sequel of cardiac lesions and as a complication of surgical procedures.

Embolism of the popliteal artery is practically always followed by gangrene (Lewis). The operation of embolectomy has been carried out successfully. Indications for and instructions for this delicate operation are furnished by Key,[3] who has operated upon 17 cases.

16. **Traumatic Gangrene.**—Partial or complete subcutaneous rupture of arteries has been known to occur following a relatively slight external trauma or following fractures or dislocations. Gregora[4] reports 4 cases in which subcutaneous rupture of a principal vessel led to gangrene of an extremity. The diagnosis is often very difficult, yet early diagnosis is of the first importance. Absence of the peripheral

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[1] Lewis, Dean: Arch. Surg., 15, 613, October, 1927.

[2] Paizis, D.: Presse méd., Paris, 1926, 34, 1242.

[3] Key, Einar: Zentralbl. f. Chir., 54, 2190, August 27, 1928.

[4] Gregora, Hanns: Brun's Beitr. z. klin. Chir., 140, 199, 1927.

pulse does not prove rupture, as it may be due to a hematoma. Moreover, peripheral pulse may be maintained in incomplete rupture. Valuable symptoms, according to Gregora, are disturbances of sensitivity and motility of the extremity. The treatment must aim at providing favorable conditions for collateral circulation. The injured vessel must be exposed and ligated, if vascular suture is not possible.

17. **Chemical Gangrene.**—Necrosis of the skin has been caused by wet dressings of dilute solutions of phenol and bichloride, and even aluminum acetate. They should *never* be employed in the treatment of infections. Prolonged spraying of fingers with ethyl chloride to produce anesthesia for the incision of infections has caused gangrene. Unskilful injections of salvarsan and hypertonic glucose so that the solution is extravasated outside of the vein has caused localized sloughing and necrosis.

18. **Bed-sore (Decubitus).**—Bed-sores occur in patients with prolonged illnesses; in relatively robust individuals they may occur as the result of unskilled nursing care. In debilitated patients and particularly in those who are paralyzed, it may be impossible to prevent bed-sores even with the most faithful care. The prevention of bed-sores is best effected by frequent changes of position of the patient, by scrupulous cleanliness of the skin and by washing with alcoholic solution in an effort to harden and toughen the epithelium. Where bed-sores are imminent in addition to this treatment dusting with a powder composed of

Pulv. camp.	ij
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is very beneficial. Where bed-sores actually have occurred, the best results in the treatment are brought about by avoidance of pressure, cleanliness of the surrounding skin, antisepsis of the ulcer, and dry applications, as the above-mentioned dusting powder and sterile gauze. Balsam of Peru and zinc oxide, recommended by many, do not seem to give as good results. Where the inflammation surrounding the ulcer is marked, hot boric fomentations may be necessary.

Eiselberg[1] attributes to von Langenbeck, in 1855, the employment of a water-bed for bed-sores. The patient is placed in the water at proper temperature, and once weekly is placed in a dry bed for twenty-four hours. While with the American Expeditionary Force in France the author treated a very severe case of bilateral bed-sores over the great trochanters by vertical suspension of both legs (Fig. 69).

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[1] Eiselberg, A.: Practitioner, 118, 213, April, 1927.

19. **Noma** is a microbic, gangrenous stomatitis, which occurs generally in children under ten, who are in a debilitated condition (Fig. 70).

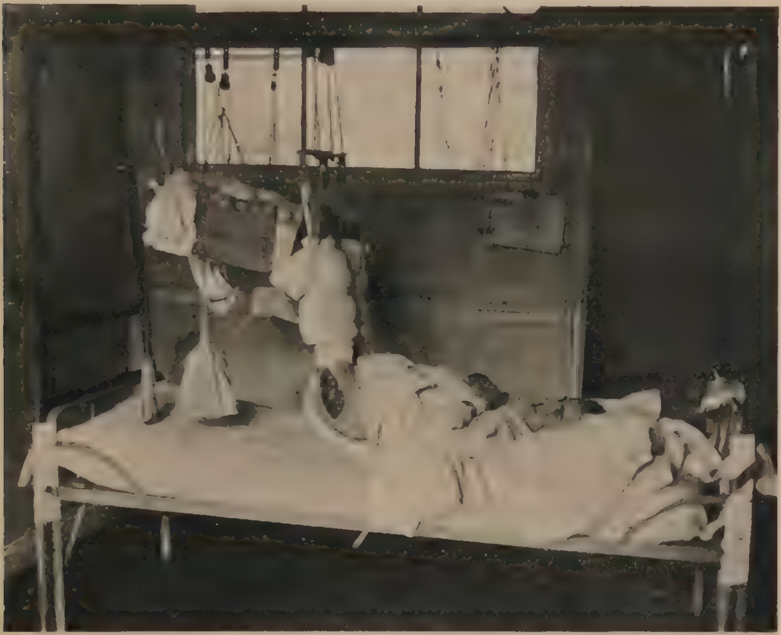

Fig. 69.—Wounded soldier, 1918. Paraplegia from gunshot wound of the spine. Large bed-sores over both trochanters. Treatment by suspension. (Author's case at American Red Cross Hospital No. 2, Paris, Dr. Joseph A. Blake.)

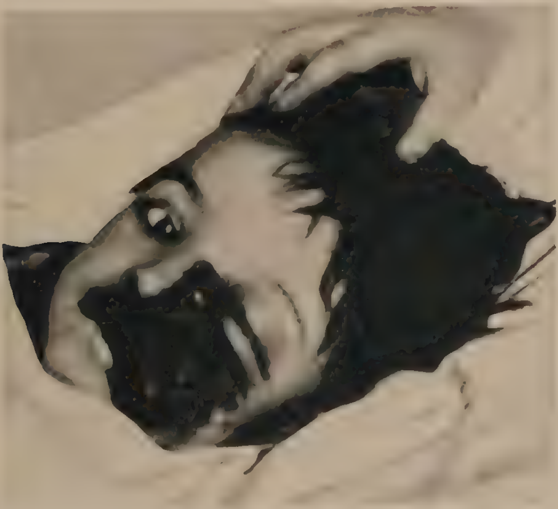

Fig. 70.—Noma. (Children's Memorial Hospital, Chicago. Courtesy of Dr. Joseph Brenneman.)

One-half of the cases follow measles. Seventy-five per cent. of the cases are fatal in ten days to two weeks. The accepted treatment at the present time consists in radical excision of the affected area with the actual cautery.

20. **Gas Gangrene.**—The morbidity of gas gangrene received additional attention and prominence during the World War. Up to this time but a few isolated cases had been described. During the World War, however, the deep punctured wounds caused by missiles brought about the implantation in the depths of the wound of portions of the intensely cultivated soil of the region.

Gas gangrene is due to the presence of anerobic organisms, chiefly the Bacillus welchii and the vibrion septique. The propagation of these organisms in the anaërobic media of the deep tissues brings about the formation of gas bubbles which are spread longitudinally in the muscle-fibers and along the fascial planes. This is accompanied by necrosis of the tissue involved and by extreme toxemia. The diagnosis is made on the history and symptoms. Any patient who has had a deep, dirty wound with traumatism of muscles should be watched for the appearance of gas gangrene. The patients have moderate elevation of temperature and a pulse curve which is elevated out of proportion to this temperature. They have a maintained and even accelerated intelligence and but a moderate amount of pain. The wound itself may show a watery discharge and smears from it may show the Welch bacillus. Often a characteristic odor may be noted. The area about the wound is swollen; and crepitus may be elicited; commonly a site far distant from the wound of entrance may be affected. The writer has seen gas gangrene of the buttock occur secondarily to a wound of the wrist. This area is always swollen and the elicitation of crepitation is pathognomonic. The early diagnosis of gas gangrene has been discussed by the author in a previous publication.[1]

The most efficient treatment is radical surgery Surgery is important in the prophylactic treatment. All devitalized tissue about wounds should be carefully removed with a sharp knife. Jagged edges and skin which obviously is doomed to pressure necrosis should be removed at the original treatment of the wound, taking care that none of the vital structures are injured. The wound should be thoroughly swabbed with antiseptic solution, preferably mercurochrome-acetone solution. Lacerated muscles are best not sutured unless

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& Drain
Serum

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[1] Christopher, F.: The Early Diagnosis of Gas Gangrene, Jour. Amer. Med. Assoc., 72, 407, February 8, 1919.

× Episcop Hospit

there is complete transverse division. Rents in the fascia should not be sutured. The wounds should be thoroughly drained with rubber tubes. These may be inserted in counter-drainage openings in the deep pocketing wounds. Gauze packing generally is unsatisfactory.

The surgical treatment of a well-developed case of gas gangrene consists in the removal of all of the affected tissue, and the provision for adequate drainage of all tissues which are under suspicion. Longitudinal incisions should be made, half again as long as is apparently necessary, in the skin and fascia (outline of treatment given out by the United States Medical Corps). Brickner and Milch[1] have called attention to the correct usage of the French terms which apply to these procedures and which came into use during the World War. "Épluchage" (for which the term "débridement" is often improperly used) refers to the cutting away of the contaminated muscles. The term "débridement" should be restricted to the free incision of skin and fascia for the purpose of releasing the tension of the contaminated muscles. After the wound has been subjected to a thorough but careful épluchage, arrangement should be made for the continuous or periodic irrigation with an antiseptic solution. For this purpose Dakin's solution is undoubtedly the best. The technic of its application is described elsewhere (p. 61). Pilcher[2] believes that the following solution is better than Dakin's solution:

Quinine sulphate	1.00 gm.
Hydrochloric acid	0.50 c.c.
Glacial acetic acid, 99 per cent	5.00 c.c.
Sodium chloride	17.50 gm.
Formol, 40 per cent	1.00 c.c.
Thymol	0.25 gm.
Alcohol, 90 per cent	15.00 c.c.
Aquæ, q. s., ad	1000.00 c.c.

This solution, however, has the disadvantage of not being proteolytic; after its germicidal value has been realized, it is generally necessary to employ Dakin's solution.

The evidence seems to be more favorable in regard to the value of gas bacillus serum, both prophylactically and curatively.[3] The best serum is probably the "polyvalent antigangrenous serum" of Professor H. Vincent, of France. This serum is prepared from twenty strains of species of bacteria, including Bacillus perfringens, B. œdematiens, B. histolyticus, B. fallax, B. sporogenes, B. putrificus, vibrion septique, etc. It is unfortunately difficult to obtain in this country. Brickner and Milch have used the Vincent serum in 4 cases without success. Professor Vincent,[1] however, has furnished us with very impressive case reports of the preventative and curative value of the serum. Vincent states as a law that "all deep wounds, all open and compound fractures of the upper and lower extremities contaminated by earth, soil, fecal material, manure, etc., demand (especially if they are treated late) the preventative injection of the antigangrenous serum of the same titre as that of the antitetanic serum which should be used in such cases."

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[1] Brickner, W. M., and Milch, H.: Internat. Clin., 4, 226, December, 1926.

[2] Pilcher, J. T.: Ann. Surg., 81, 198, January, 1925.

[3] Baldwin, J. H., and Gilmour, W. R.: Ann. Surg., 85, 161, February, 1927.

Joseph[2] reported 2 cases, both severe injuries of the pelvis, which developed gas gangrene and recovered after the use of the perfringens serum. Benton[3] reported a case of Welch bacillus infection complicating compound fracture which recovered following operation and the use of anaërobic antitoxin serum. Weinberg[4] recommends the use of antigangrene serum in civil practice. He says that in certain cases of appendicitis, puerperal sepsis, and lung gangrene it may save life as in these conditions the organism causing gas gangrene may be present. Antigangrene serum may be obtained commercially in the United States.[5]

The occurrence of gas gangrene in civil practice has been receiving an increasing amount of attention. In 1922 the writer reported a case of gas bacillus infection of the hand following a crushing injury. It was successfully treated by épluchage, Dakin's solution, and incomplete amputation.[6] Ochsner and Schmidt[7] reported the case of a gas bacillus infection of the abdominal wall following an appendectomy for perforative appendicitis associated with abscess formation. The case recovered. Butler[1] reported 2 cases of gas bacillus infection of the abdominal wall in a series of 7000 laparotomies. One case occurred after an appendectomy and the other after a colostomy. The 2 cases were treated by multiple incision and one of them survived. Gas bacillus infections have occurred following the hypodermic injections of various medicaments. Heuss[2] reported gas gangrene after the injection of caffeine and digitoxin to a patient with purulent peritonitis. Gas bacilli were subsequently found in the injected solution, but six other patients in which the same injection fluid was used remained healthy. Anschutz[3] reported a case of gas gangrene after subcutaneous injections. Wanke[4] was able to collect 25 cases of such infections, and this writer stresses the importance of boiling all the needles for five minutes. Lande[5] reported 3 additional cases of gas gangrene following subcutaneous injections. This writer believes that the gas bacillus germs are present on the skin. Tenopyr[6] reports 24 cases of gas bacillus infection in civil surgery with a mortality of 29 per cent. Muscles which have been devitalized not only by trauma, but also by impaired circulation, are a prey to gas bacillus infection. In 1927 Tanner[7] reported 7 cases of gas bacillus infection complicating senile and diabetic gangrene of the lower extremities. In 5 cases the infection developed in amputation stumps. In 1 case of arteriosclerotic gangrene of the great toe and ulcer on the dorsum of the foot, the Bacillus welchii was found in anerobic culture. Weintrob and Messeloff[8] made a study of 85 cases of gas gangrene found at Bellevue Hospital, New York, and found it occurred once in every 7310 cases. In no case was serum used and the mortality was 45.9 per cent.

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[1] Vincent, H.: Internat. Clin., 4, 138, December, 1925.

[2] Joseph, Morris: Ann. Surg., 87, 772, May, 1928.

[3] Benton, N. K.: Amer. Jour. Surg., 5, 345, October, 1928.

[4] Weinberg, M.: Seuchenbekaempfung, 1927, iv, 79, 145.

[5] The Perfringens Antitoxin, manufactured by H. K. Mulford Company, of Philadelphia, Pa., is prepared from the blood-plasma of horses highly immunized against the toxin of Bacillus perfringens, or Welch's bacillus. Parke, Davis and Company, of Detroit, supply an antitoxin that may be employed for the prevention of both tetanus and gas gangrene. It is supplied in syringe containers containing 1500 units of tetanus antitoxin and 10 units of Perfringens Antitoxin of about 10 c.c. volume. A similar product is made by the Lederle Company.

[6] Christopher, Frederick: Internat. Clin., 1, 129, Series 32, 1922.

[7] Ochsner, A. J., and Schmidt, E. R.: Surgical Clinics of North America, 5, 911, August, 1925.

21. **Infectious Gangrene.**—Certain types of gangrene due to the hemolytic streptococcus have been described by Meleney.[9] This particular infection causes a rapid destruction of tissues and is amenable only to surgery. Multiple incisions, hot soaking, Carrel-Dakin treatment, and skin-grafting in the case of large ulcers are the usual measures taken. In 1924 there were first described cases of a peculiar, spreading,

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[1] Butler, D. D.: Ann. Surg., 84, 841, December, 1926.

[2] Heuss, H.: Med. Klin., 21, 470, March 27, 1925.

[3] Anschutz, W.: Beitr. z. klin. Chir., 139, 129, 1927.

[4] Wanke, R.: Deutsch. Ztschr. f. Chir., 199, 214, 1926.

[5] Lande, K.: Med. Klin., 22, 924, June 11, 1926.

[6] Tenopyr, James: New York State Jour. Med., 27, 16, January 1, 1927.

[7] Tanner, E. K.: Surgical Clinics of North America, p. 1099, August, 1927.

[8] Weintrob, M., and Messeloff, C. R.: Amer. Jour. Med. Sci., 174, 801, December 1927.

[9] Meleney, F. L.: Arch. Surg., 9, 317, September, 1924.

carbuncular infection[1, 2] (Fig. 71). This infection seems to be due to no one organism, but to a group of them. It progresses peripherally in a creeping manner and is not amenable to any of the ordinary treatments, as hot boric fomentation, Dakin's solution, sunlight, etc. It may be cured by the periodical removal of the carbuncular masses by the actual cautery. Two other cases were described in 1926.[3]

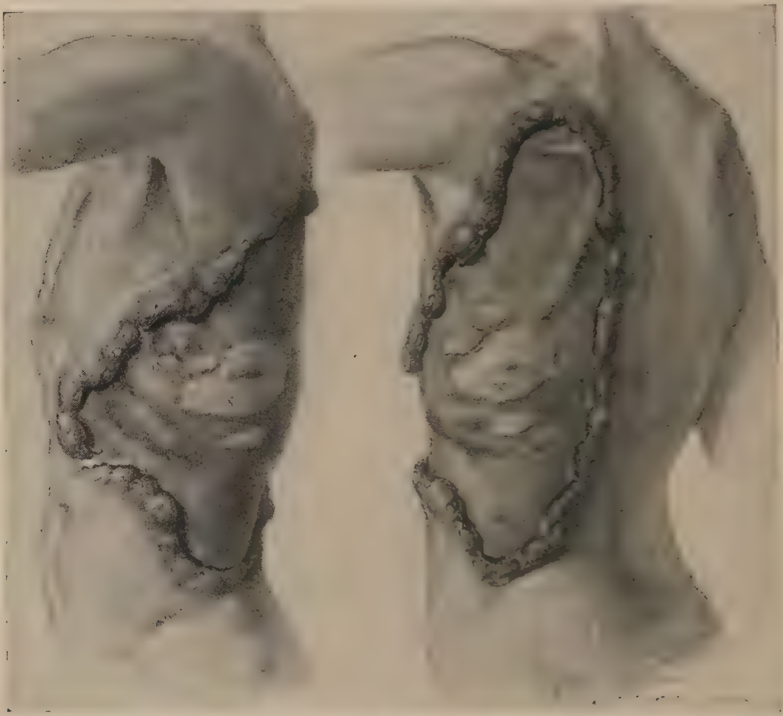

Fig. 71.—Spreading carbuncular infection of the chest wall. Cured by cautery excision. (Christopher, Frederick, Surgical Clinics of North America, June, 1924.)

21. **Exposure to Cold.**—Prolonged exposure to intense cold may cause the freezing of the tissues. In the severe cases gangrene will result. In the mild cases of repeated exposure to cold *chilblains* will result. The skin assumes a violet-red color, and there is swelling and numbness of the part. On the first exposure to the cold, and with the repeated exposures, a constant burning and itching results (chilblains). In the treatment of mild exposures to cold which might induce chilblains the part will be washed in cold water and bathed with alcohol. According

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[1] Cullen, T. S.: Surg., Gynec., and Obst., May, 1924.

[2] Christopher, Frederick: Surgical Clinics of North America, June, 1924.

[3] Brewer, G. E., and Meleney, F. L.: Ann. Surg., 84, 438, September, 1926.

to Vaughan and Burnham,[1] glycerin, either alone or in combination with boric acid or tincture of iodine, is of value. Mitchell[2] treats chilblains by the principle of direct elastic pressure. Thin pieces of rubber of the weight of medium rubber gloves are used in strips of tubing, $\frac{3}{4}$ to 1 inch wide. These are applied over the affected parts and can be worn on the leg even during walking. In the treatment of the hands firmly fitting rubber gloves are worn at night only. The

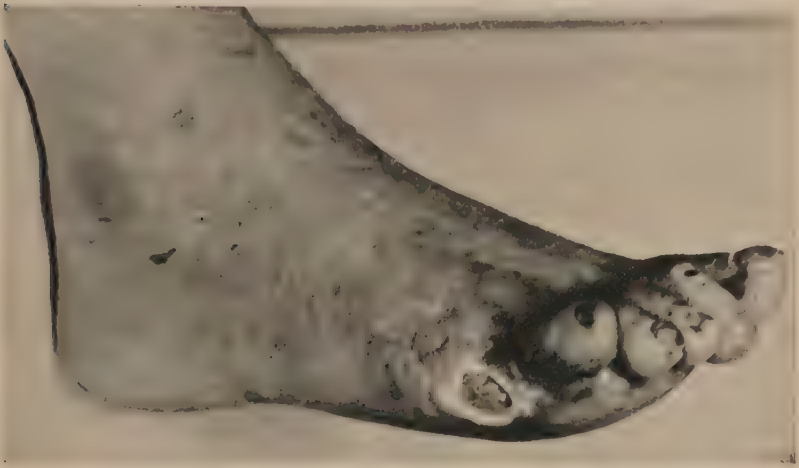

Fig. 72.—Trophic ulcer of the foot following frost-bite.

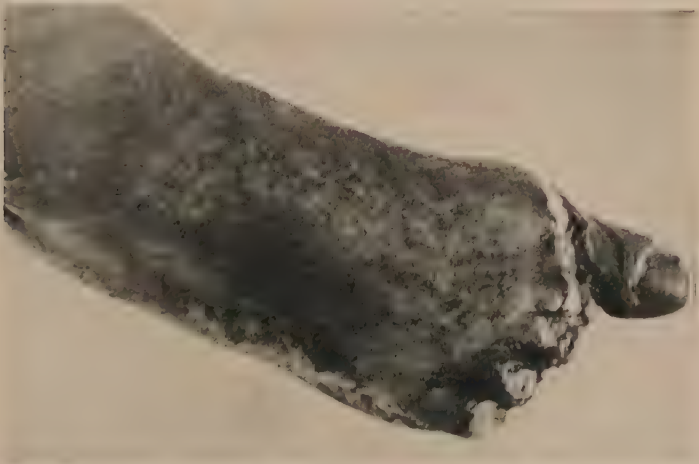

Fig. 73.—Gangrene of great toe and amputation of smaller toes following frost-bite.

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[1] Vaughan, J. C., and Burnham, A. C.: Minor Surgery, Lea & Febiger, 1922, p. 37.

[2] Mitchell, L. J. C.: Med. Jour. Australia, 1926, ii, 449.

condition is relieved instantly. After a few days the part is normal except for a slight desquamation. If the skin is broken, boracic powder and a sterile dressing should be applied under the rubber band.

In the treatment of the cases of exposure to extreme cold (*frost-bite*) the first measure is the rubbing of the part with snow or cold water. Some say that warm water is almost as beneficial as snow. The part is washed with soap and water and alcohol. A sterile dressing is applied and, if necessary, the bullæ are punctured. After the sloughs have separated the infected wound will be treated along the principles previously laid down (Fig. 72). Amputation may in some cases be necessary after the line of demarcation has formed (Fig. 73).

CHAPTER VIII

INJURIES OF THE HEAD

I. INJURIES TO THE SCALP

1. **Abrasions of the Scalp.**—All abrasions of the scalp must be treated with respect because of their being the potential causes of suppuration or cellulitis. The latter are serious because of their tendency to spread, with possible extension to the meninges. It is most desirable to clip the hair and shave the affected area. If the abrasion is slight, however, and the site is in a conspicuous situation, it may be wise to assume the additional risk and leave the hair on. In either case the area should be carefully cleansed of macroscopic dirt and treated with an antiseptic. For this purpose 2 per cent. mercurochrome, 1 : 2000 "metaphen," and half-strength tincture of iodine are most desirable. If the area has been shaved, it is probably wiser to apply a small dressing. Unless there are valid objections against this, this dressing is best held in place by a head bandage. A less conspicuous dressing is the application of a small circular patch of gauze which is attached to the scalp by a ring of liquid adhesive or by tiny strips of adhesive plaster which may by force of circumstances be allowed to attach themselves to the hair. The dressing and wound should be inspected until a clean dry crust has formed. In case the abrasions become infected, it will be mandatory to clip and shave the scalp in that region and to treat it with hot boric fomentations. Where it is impossible to use hot boric fomentations a less valuable method is to paint the area with mercurochrome or other antiseptic and apply a thin coating of white sterile vaseline or mercurochrome ointment before the gauze bandage is applied.

2. **Contusions of the Scalp.**—All contusions of the scalp should be regarded as possibly having serious consequences. The patient himself is rarely able to give an accurate opinion as to the amount of force involved in the injury. Contusions of the scalp which appear to be innocent may be the sole indication of more serious injury. Concussion of the brain and fracture of the skull with or without depression may be present. Although undesirable sequelæ of head injuries generally occur within the first six hours, all contusions of the scalp should

be kept under observation for at least twenty-four hours. Large contusions of the scalp may develop into a hematoma. Superficial extravasations of blood are generally small in amount and do not tend to spread. If the extravasation of blood is below the aponeurosis it may spread over a considerable area of the skull. If the blood is beneath the pericranium, the condition is termed a "cephalematoma." A hematoma may show a soft depressed center which gives a crater-like sensation to palpation, and has been mistaken for and operated on as a depressed fracture of the skull.

The *treatment* of contusions of the scalp is the application of cold, and bodily rest for the patient. It is far better to have the patient spend a number of unnecessary hours in bed than to risk early ambulatory treatment of a brain injury. Most hematomata of the scalp absorb spontaneously. Others become fluidified and a persistent fluctuation warrants an attempt at aspiration, or incision.

Where it is desired to evacuate the contents of a *hematoma of the scalp*, the hair is clipped and shaved for a circumference of about 2 inches, and the skin is painted with tincture of iodine. An aspirating needle is then introduced into the cavity of the hematoma and if the blood be fluid, it is aspirated. If the blood be clotted, the skin will be infiltrated for a distance of about an inch with local anesthetic solution and an incision about ½ inch long will be made. The edges of this incision will be divulsed by a scissors or hemostat and the clots expressed by pressure upon the outside of the hematoma. Vaughan and Burnham advise removing the remaining clots by means of gauze swab dipped in alcohol or in 5 per cent. carbolic acid. After cleansing of the cavity a snug bandage will generally bring about adhesion between the inner walls of the hematoma. A suture will rarely be required, but should it seem to be indicated, it is introduced loosely without drainage. Hematomata which have become infected, either before or after evacuation, will have to be drained. The diagnosis of infection of a hematoma is readily made by the presence of pain, redness, swelling, and tenderness.

(*a*) *Cephalhematoma or, More Properly, Cephalematoma.*—The term "cephalematoma" is applied to a collection of blood beneath the pericranium. This condition, as Harvey Cushing[1] says, possesses considerable surgical importance "not only in itself, but because it is often a tell-tale of intracranial stasis." In the infant the effusion generally is limited by the size of the already formed bone. Cushing also has found extradural and subdural extravasations. Even when large the hematoma rarely leaves the confines of a single bone (Cushing). A cephalematoma is commonly confused with a *caput succedaneum.* The latter is a circumscribed area of edema of the scalp which is caused by uneven pressure in the birth canal. The caput succedaneum does not conform in outline to one of the bones; it pits on pressure; it does not fluctuate, and it disappears a few days after birth. A cephalematoma tends to increase in size. The diagnosis is more difficult when the cephalematoma is surmounted by a caput.

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[1] Cushing, Harvey: Keen's Surgery, 3, 92, 1916, W. B. Saunders Co.

Many cephalematomata will subside under expectant treatment. The "let alone" treatment is not without peril, however, as the development of infection is liable to occur in cephalematomata of long standing where no operation has been performed. The case quoted by Vaughan and Burnham[1] is illustrative of the danger of the conservative plan of treatment. "A full-term, nine-pound, healthy baby was delivered instrumentally after a prolonged labor. After a few days the subsistence of edema of the scalp showed a right parietal cephalematoma. This was treated conservatively and became softer after the fifth or sixth day, but never showed the signs commonly associated with infection. On the ninth day fever and convulsions developed and aspiration of the hematoma showed thin sanguineous pus. Two days later the child died of septic meningitis." Vaughan and Burnham recommend incision and evacuation of the clotted blood on the fourth or fifth day. Cushing's rule is to wait for two weeks and if there be no sign of subsidence, to incise and evacuate the clot. If longer delay were safe, the lifted pericranium may give rise to an adventitious bone deposit with a permanent extracranial deformity. After the evacuation of the clots a bandage is carefully applied to cause the separated edges of the cephalematoma to adhere.

(*b*) *Hematoma of the Ear* (*Boxer's Ear, Cauliflower Ear*).—This consists of an extravasation of blood beneath the perichondrium of the ear, causing a rounded fluctuating tumor. This hematoma should promptly be aspirated or incised, the clot evacuated, and the incision neatly sutured. A snug bandage over the ear will prevent its recurrence.

3. **Wounds of the scalp** comprise perhaps the largest single group of ailments treated in minor surgery. Most commonly they are caused by blows, as falls on the pavement or by being struck by blunt objects. Such blows may cause a jagged, lacerated wound, the edges of which show devitalization and contusion or they may cause a clean linear wound as if it had been incised. Incised wounds of the scalp are less common, but occur. Punctured wounds are rare. Because of the

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[1] Vaughan, J. C., and Burnham, A. C.: Minor Surgery, Lea & Febiger, 1922, p. 1140.

extreme vascularity of the scalp all of its wounds bleed copiously, greatly to the alarm of the patient and those near him. By the time the physician arrives this hemorrhage generally has ceased. If one be present at the time of injury, the best first-aid treatment is the application of a pack of sterile gauze, or in lieu of this a clean towel or handkerchief. Pressure is then applied firmly on this pack and bleeding can practically always be controlled unless large vessels, as the temporal, occipital, posterior auricular, and supra-orbital arteries, have been severed (Fig. 74). Here clamp and ligature will be necessary. The toothed hemostat is the best for scalp work.

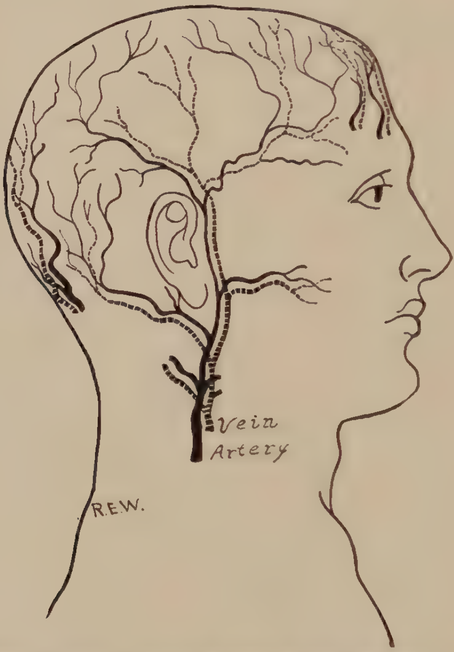

Fig. 74.—Diagram showing vascular supply of the scalp. The middle temporal branch of the external carotid artery passes upward on the anterior side of the ear and divides into anterior and posterior branches. The auricular artery passes behind the ear. The occipital artery branches off from the external carotid, and after passing beneath the sternomastoid muscle supplies the posterior region of the scalp.

The first step in the treatment of a scalp wound is the preparation of the field. The skin should be clipped and the scalp shaved (use shaving soap and a sharp razor) for an area of at least 1 inch about the wound margins. This should be done as gently as possible in an effort to prevent fresh bleeding. After the area has been shaved and cleansed with clean water, the grease, if any, must be removed by benzine or ether. The dry blood should be removed, and after the blood has been washed away from the hair outside of this area the wound should be treated with an antiseptic. For this purpose 2 per cent. mercurochrome, 1 : 2000 metaphen, or, last, tincture of iodine is advisable. The skin and wound edges should be thoroughly painted, and finally a cotton applicator saturated with the antiseptic used should be placed in the wound. Whereas fresh bleeding with copious outpouring of blood mechanically washes out many micro-organisms, it is advisable where it can be done without too great a disturbance to cleanse the interior of the wound with an antiseptic. If very gently performed, this procedure may not stir up fresh bleeding. If, however, fresh bleeding occurs, it will have to be controlled by pressure or by suture. A great deal of time is lost and a great deal of unnecessary pain is caused to the patient by attempts to grasp these bleeders in the scalp by hemostat and to ligate them. This is rarely necessary, for the bleeding will be controlled by mere pressure or by the sutures which are used to coapt the wound edges. Occasionally hemorrhage from the scalp apparently may be controlled by suture of the skin, but in reality the hemorrhage may be continued underneath the scalp and a hematoma will form. This difficulty may be avoided by proper wound suturing, by the occasionally necessary hemostasis of the depths of the wound, or by the introduction of a small rubber-tissue drain. Should a hematoma form, it should be evacuated by divulsing the wound edges or by the aspiration under sterile precautions. If the edges of the wound be extremely ragged and devitalized, quicker healing will be insured by a débridement of these edges. The ragged ends are removed by means of a sharp scissors or sharp scalpel. Gross particles of dirt should be removed from the interior of the wound. *Under no circumstances should the physician probe the depths of the wound in search of a possible skull fracture.* The existence of skull fracture is determined far more reliably by the *x*-ray and by clinical observation than by any amount of probing. A linear slit in the galea may simulate a fracture. Moreover, the probing is a serious danger because of the likelihood of the introduction of infection.

Many more scalp wounds are sutured than really require this treatment. Inexperienced physicians who are alarmed at preliminary hemorrhage will place sutures before they have made a serious attempt to control the hemorrhage by the application of pressure and before the defensive of clotting has fully been exercised. Wounds up to $1\frac{1}{2}$ inches in length will heal very kindly without being sutured, and generally with much less danger of sealing pyogenic organisms in the wound. The surgeon may best expend his effort in industrious cleansing and antisepsis and the application of a comfortable and well-fitting bandage than in the introduction of sutures in a small wound.

In the event that closure of the wound is decided upon, adhesive plaster bridges are suitable for small wounds where the surrounding skin has been sufficiently shaved to permit their application. Michel clips are less suitable and the best method is the insertion of fine, non-absorbable suture material. For this purpose silk, "dermal suture," and horsehair are preferable. Silkworm-gut is too stiff and too thick to be suitable and catgut should never be employed. Strong cutting needles should be employed. Sutures in the scalp may be introduced without anesthesia in all but the most apprehensive, and in young children. Where anesthesia is thought to be necessary, local anesthesia in the wound edges is more troublesome to employ, but is most suitable. General anesthetic may be needed in large wounds and in young children. Small wounds are sutured without drainage. In cases where the wound is 5 or 6 inches long, so that an actual flap of scalp has been turned back, it is often advisable to make a counter-drainage, opening at the base of the flap, and to insert in this opening several twisted strands of silkworm-gut or a small portion of soft rubber-tubing as a drain. Sutured scalp wounds should be inspected at least every twenty-four hours for the first five days for signs of infection. This is manifested by pain about the wound, by redness, slight swelling, and occasionally by the appearance of a droplet of pus at the stitch wounds or at the wound itself. At the first sign of infection the stitches should all be removed. If the infection is slight, simple removal of the sutures will suffice. If, however, there is a more marked disturbance, moist boric dressings will be indicated.

4. **Avulsion of the Scalp.**—This serious accident, which is scarcely germane to the field of minor surgery, will be but briefly mentioned. It occurs in accidents where the hair has been caught in machinery and portions of the scalp torn off. Where the portion of the scalp which has been avulsed is attached by a broad pedicle, it may be cleansed and replaced with sutures at the borders and appropriate counter-drainage at the base of the flaps with reasonable assurance of successful result. Where the entire flap has been removed, and a large area of bare periosteum or skull exposed, the best treatment is probably that which dates from the day when scalping by the Indians was a relatively common occurrence. An unknown physician hit upon the expedient of trephining through the outer table of the skull numerous small holes. Through these small holes abundant granulation tissue formed and coalesced, so that the entire area eventually

became covered with a clean granulating surface which should be skin-grafted with Thiersch grafts.[1]

5. **Burns of the scalp** are of far less frequent occurrence than burns of the face and neck because of the protection exercised by the hair. The practice of permanent waving has been the cause of numerous burns of the scalp. These burns are generally endured by the patient victim on receiving assurance that everybody else has suffered in the same manner. They should be treated with great care as to antisepsis because most frequently they become infected. The writer has seen a case of marked cellulitis of the scalp and face resulting from a permanent-wave burn which was so serious as to cause the closing of both eyes. This patient required hospitalization and treatment with moist compresses. There was ultimately complete loss of hair in an area about an inch and a half in diameter. Extensive burns of the scalp are best treated by clipping the hair and the application of 5 per cent. tannic acid ointment, until the burned area has been thoroughly tanned. After the formation of a dry crust this should be watched with extreme care, because of the danger of sepsis and any suppuration should be treated either by wet dressings or by removal of the portion of crust which covers the infected area.

6. **Abrasions of the Face.**—Small abrasions of the face are best treated by careful cleansing of the wound and surrounding skin with water, if dirt be present, and then the application of an antiseptic. For this purpose 2 per cent. aqueous solution of mercurochrome is found to be the best, but the marked stain which is so conspicuous on the face is objectionable. Perhaps the most suitable is to sponge the abrasion with alcohol or simply with a boric acid solution. Iodine is unnecessary and painful. The wound is then encouraged to dry. If secretion forms this is removed by gently sponging with applicators saturated with boric solution or with small pledgets of gauze. The wound itself is left freely exposed to the air and is sponged whenever the secretion becomes too profuse. In a very short time the secretion will dry and a clean scab will form. This is not covered by any protective dressing and when the epithelium beneath it heals, will fall off without further treatment. The patient, of course, is cautioned not to touch the dry wound or the subsequent scab with his fingers because of the risk of infection. In certain cases where it is impracticable to devote this amount of attention to an abrasion, it will be necessary to cover the wound with a dressing. Before the dressing is applied, however, a thin coat of sterile vaselin, or sterile borated vaselin, should be applied to

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[1] Coleman, Everett, P.: Illinois Med. Jour., 49, 40–43, January, 1926.

the wound and the dressing may then be fixed in place by small pieces of adhesive plaster. Under no circumstances should collodion or "new skin" be painted upon the abrasion. The writer has known of a case of tetanus arising from an abrasion of the face incurred by a fall on the street and treated by collodion. Following blast injuries, dirt, powder grains, coal-dust, and, under other circumstances, portions of emery from emery wheels may be driven into the skin. Falls in cinder driveways have been known to grind into the skin small particles of dark-colored cinders. These particles are exceedingly difficult to remove, but a very earnest effort should be made to do so as soon after the accident as possible. For this purpose it will frequently be necessary to give a general anesthetic and to scrub the abraded skin with gauze pledgets or actually to scrape it with a stiff sterile brush. If these procedures be not taken, often a very disfiguring permanent discoloration of the skin will occur.

7. **Contusions of the Face.**—Practically all portions of the face swell very readily following blows. Contusions of the face are manifested by rapid swelling and pain. Some areas, such as the lip, are particularly prone to become swollen. A second characteristic of contusions of the face is their likelihood to have ecchymosis. Such ecchymosis is particularly liable to occur in the neighborhood of the orbit. It will be remembered in the consideration of ecchymoses of the face, or any other portion of the body, that the ecchymosis very often occurs at a site that is more dependent than that of the injury. A blow of the scalp or brow will cause ecchymosis of the upper lid and even of the lower lid. Ecchymoses in the region of the orbit should never be lightly dismissed on the grounds that they occur from a simple contusion of the soft parts. They should be observed and suspected of being related to injury to the underlying osseous system. If the ecchymosis involves both orbits on the nasal side and if it appears some forty-eight or seventy-two hours after the injury, the evidence strongly indicates a fracture involving the orbital plates or the base of the skull. Likewise, a bilateral subconjunctival ecchymosis must be considered a suspicious sign of skull fracture. Unilateral subconjunctival ecchymosis or hemorrhage which occurs almost immediately after the injury will generally be explained by a contusion of the conjunctiva itself. Likewise, ecchymoses of the orbit which occur very soon after the injury may be attributed to injury to the soft parts of the orbit itself. All ecchymoses in this region which cannot be explained upon simple grounds should be observed on the basis of a possible skull fracture. The treatment of the local condition of contusion of the face is the

application of cool or cold moist compresses. Extensive ecchymoses on the forehead may develop into fluidified hematomata which may require aspiration. Later hot fomentations will facilitate absorption. Contusions in the region of the supra-orbital nerve are extremely painful and may cause a temporary anesthesia of the portion of the scalp supplied by that nerve.

8. **Incised and Lacerated Wounds of the Face.**—The face is very frequently the site of incised wounds, particularly nowadays because of shattered glass from windshields in automobile accidents. The chief concern in the treatment of these wounds is the promotion of healing with a minimum amount of scar formation. To this end, after careful cleansing and treating of the wound with an antiseptic, the edges are approximated with very fine non-absorbable suture material which is placed by a very fine curved cutting needle. The sutures are introduced about $\frac{1}{8}$ inch apart and are carefully tied so that there is no inversion of the skin edges. The best suture materials for wounds of the face are horsehair, fine twisted silk, or the so-called "dermal suture." The earlier the sutures are removed, the less will be the scar formation; generally the second or third day is the best time. Michel clips will make a very satisfactory closure of face wounds. Their application causes less pain than the introduction of sutures, but is more difficult. In the case of children a general anesthesia is frequently necessary. Most adults, however, will readily tolerate the placing of a few sutures without anesthesia, but in the more apprehensive individuals the injection of the wound margins with 1 per cent. or $\frac{1}{2}$ per cent. novocaine solution will render the insertion of the stitches completely painless. This procedure takes very little time and is greatly appreciated by the patient. Small ampules, 1 to 2 c.c. in size, containing local anesthetic solution are on the market. A small hypodermic syringe with a very fine gauze needle having a short bevel should be used for injection. If any reliance may be placed upon the intelligence of the patient, these wounds, after having been sutured, are best left exposed to the air. The patient is instructed not to touch these wounds with his fingers and to carefully sponge them off every two or three hours with boric acid solution. Where the minimization of scar formation be desirable the boric sponging had best be done every fifteen minutes until the wound is thoroughly dry. Where these procedures are not feasible, it is advisable to cover the wound with a dry gauze dressing, held in place by sterile adhesive.

In case of *wounds of the lower lip and chin*, particularly in children, the placing of gauze dressings has actually a detrimental influence.

It is impossible to keep these dressings clean and dry and they very soon become saturated with saliva and fluid food, and upon removal the wound will be found to be macerated and infected. The open-air treatment is generally much preferable.

If sutured wounds of the face show redness, swelling, and discharge at the wound margins, infection may be suspected. This may be superficial and amenable to repeated sponging with boric solution, but if the pain and amount of disturbance indicate deep infection the sutures should be removed and warm boric dressings applied. Accurate approximation of the wound edges is important in all wounds of the face. It is important that the bite of the needle on each side of the wound be equally placed from the edge of the wound. It is important that the skin edges be not invaginated, as a more conspicuous scar will result.

Wounds which sever the ear require accurate approximation with interrupted sutures. It is surprising how beautifully these wounds will heal even though more than half the ear be severed from its pedicle. It may be necessary to apply a bandage to the sutured ear. In this case a loose gauze fluff should be placed behind the lobe of the ear before the circular head bandage is applied. Wet dressings should under no circumstances be used in freshly sutured, clean wounds of the ear and face.

Incised and lacerated wounds of the face are very frequently of importance because of the structures involved in the wound beneath the skin. Wounds of the brow have been known to sever the supraorbital nerve and to cause anesthesia of the affected scalp until regeneration of the nerve takes place. This generally occurs without suture. The facial nerve may be cut in the wounds of the side of the face and cause a facial paralysis (Fig. 75). These injuries will require nerve suture frequently. Stenson's duct may be cut in wounds of the cheek. As a result of section of Stenson's duct, a very distressing condition is created in which the saliva drains out on the cheek. According to Dickinson[1] primary repair of the duct should always be attempted as in some instances it is followed by very gratifying results. Secondary repair is much more difficult and its results are not always so satisfactory. Probably the most satisfactory and easiest method of dealing with fistulæ of this portion of the duct consists in converting the external fistula into an internal one. Wounds into the substance of the parotid gland will cause a parotid fistula which generally, however, heals spontaneously.

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[1] Dickinson, A. M.: New York State Jour. Med., 1927, 27, 548.

Wounds of the cheek and of the lips may be of such depth as to involve the mucous membrane and penetrate into the mouth. If these wounds be larger than ½ inch in length, it is generally desirable to suture them. In this case the sutures are neatly applied to the skin side of the wound, so that the bites of the needle penetrate through from one-fourth to one-half of the thickness of the cheek. *The open wound on the mucous membrane side of the cheek is not sutured.* This portion of the wound is always infected by the organisms of the mouth and will heal from the bottom very kindly if no sutures be applied. A very common accident is for people, particularly children, to fall in such a manner that a tooth is driven through the lip. Most frequently these wounds merely penetrate part-way through the lip from the mucous membrane side. Such wounds require no treatment other than a mildly alkaline antiseptic mouth-wash five or six times daily. Occasionally the tooth may penetrate the entire lip and cause a wound on the external surface. Unless this wound is very large no treatment will be required other than that employed in a partial penetration. Large wounds of this type should be sutured on the skin side only.

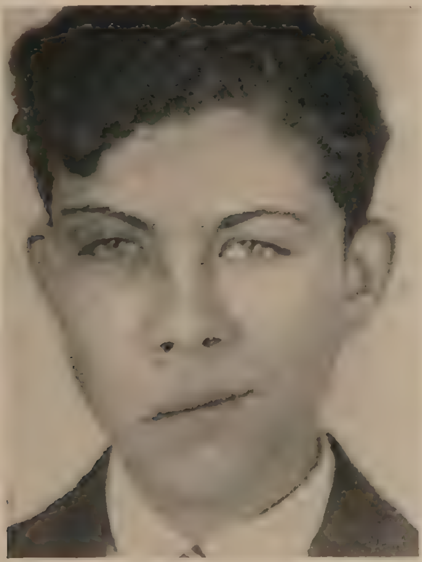

Fig. 75.—Example of right-sided facial paralysis. (Northwestern University Medical School. Courtesy of Dr. Loyal Davis.)

The eyeball itself is subjected to all varieties of wounds. If the conjunctiva alone be merely scratched, the instillation of a 1 or 2 per cent. aqueous solution of mercurochrome or of a 5 per cent. argyrol solution two or three times daily will suffice for treatment. If there be a scratch or an *abrasion of the cornea*, this condition will require the services of an ophthalmologist. The infection which may result from such trivial scratches of the cornea may bring about its ulceration. Wounds which cause penetration of the anterior chamber should be given first-aid treatment of the instillation of a mild antiseptic and should be immediately referred to an ophthalmologist. A small *puncture wound of the cornea*, which permits the escape of the aqueous humor of the anterior chamber, is not necessarily very serious, and good recoveries generally follow. Wounds of the conjunctiva may be sutured with fine catgut after a preliminary irrigation with a mild antiseptic and débridement if the edges are ragged. Wounds of the eyelid are closed with very fine interrupted horsehair or catgut sutures.

Animal bites of the face are particularly liable to infection and their roughened edges will adapt themselves to accurate approximation. Bites of dogs which are suspected of being rabid present a difficult problem. Ordinarily such wounds should be thoroughly cauterized with fuming nitric acid, but the marked increase in the amount of scar formation which this procedure brings about makes its omission desirable. It is better in this case to thoroughly cleanse the wound with ordinary antiseptic, suture loosely if necessary, observe the dog, and if necessary administer the antirabic treatment (see section on Rabies).

Puncture wounds of the face result from falls on nails, pitchforks, or are made by awls, ice-picks, etc. Outside of the chief danger, that of involving the eye, they merit consideration because of the likelihood of tetanus infection and of penetration of the sinuses.

9. **Wounds of the Tongue and Soft Palate.**—Not uncommonly children will fall upon sharp objects with their mouths open and wounds of the soft palate will occur. These wounds will require careful approximation with interrupted silk sutures placed by means of a small curved cutting needle under general anesthesia.

Wounds of the tongue most commonly result from falls on the chin when the tongue is between the teeth. Such wounds may be very severe. Most of these wounds are best treated without suture. Wounds 1 to 1½ cm. in length with wide-open, gaping edges will heal rapidly and cleanly with no other treatment than the periodic use of a mild antiseptic mouth-wash. Where the tongue is very badly lacerated so that a portion of it hangs to one side, the introduction of two or three interrupted silk sutures will bring about cure.

10. **Burns of the face** result from many causes. Hot water, steam,

gasoline explosion, explosions of gas stoves, and the like have caused burns of the face. Mild first-degree burns of the face which cause a simple erythema require no other treatment than the application of a soothing ointment, such as cold cream or even talcum powder. All other burns of the face are best treated by the application of a liberal quantity of 5 per cent. tannic acid ointment. In the absence of tannic acid ointment, sterile white vaselin, "butesin-picrate ointment," and "unguentine" are of service. Never use butter, flour and water, or lard. It is generally more comfortable to place over this ointment a single layer of sterile gauze. The ointment should be renewed every five or six hours if it is wiped off accidentally. At the end of twenty-four to thirty-six hours this treatment should be discontinued and the face treated by the open-air method. If the burns be of the second or third degree, and sloughs form, their treatment will be that indicated in the section on Burns.

II. HEMORRHAGE FROM THE HEAD

1. **Hemorrhage from the scalp** is perhaps the most common affliction in the domain of minor surgery. The hemorrhage is always very profuse and often very alarming to those not acquainted with the nature of the vascular supply of the scalp. The scalp is richly supplied with vessels which bleed violently even from a small wound. These hemorrhages generally are readily controlled by direct pressure or by sutures which approximate the edges of the wound. The exceptions to this are in cases where large vessels, such as the temporal artery, have been severed. In this event grasping the severed vessel with a hemostat and ligation will be necessary. In case this is not feasible the hemorrhage can be controlled by passing a deep suture beneath the bleeding point and ligating the tissues *en masse* in that locality. Severe hemorrhage from the scalp from multiple wounds may be controlled by tightly applying a circular tourniquet about the base of the skull, and over the brow. If this tourniquet be constricted tightly enough it will obstruct the arterial circulation and the hemorrhage will cease. This measure, however, rarely is necessary. The treatment of hemorrhage from the scalp is closely wound up with the treatment of the wound itself. (See section on Scalp Wounds, p. 149.)

2. **Hemorrhage from the Face.**—Hemorrhage from wounds of the forehead rarely is alarming. On the cheeks, however, where the vascular supply is more profuse, serious hemorrhage may take place. Large branches of the facial artery may be severed and will require prompt ligature. The measures of direct pressure which are applicable upon

the scalp are scarcely feasible upon the face because of the irregularity of the underlying bony surface and because of the mouth. Face wounds are of very frequent occurrence because of broken glass from windshields in automobile accidents. A recent case emphasizes this point. The patient suffered numerous wounds of the face and scalp, particularly two wounds of the left face, one of which entered the buccal cavity, and the other severed the facial artery. By the time a physician arrived at the scene of the accident the patient had lost so much blood as to be almost in a state of shock. The physician grasped the vessel with an unsterile hemostat and ligated it to the best of his ability under the trying circumstances. Although still actively bleeding the hemorrhage was far less profuse and the patient survived the trip to the hospital. Ultimate recovery was effected after a blood transfusion, although in this case, unfortunately, the facial nerve and parotid duct were severed. Where a hemostat is not available, deeply passed sutures often will control the hemorrhage.

3. **Hemorrhage from the Nose (Epistaxis).**—The causes of epistaxis are numerous. Most commonly, the bleeding will be caused by blows upon the nose and by fractures of the base of the skull. Removal of dried secretions in the anterior nares, ulceration of the septum, vicarious menstruation, tuberculosis, lues, malignant disease, nasal polyps, angiomata, diphtheria, scarlet fever, purpura, scurvy, leukemia, high arterial blood-pressure, renal and hepatic diseases have been mentioned. In cases of bronchitis, emphysema, and cerebral congestion there may be sufficiently high venous blood-pressure to bring about epistaxis. Alterations in atmospheric pressure, such as brought about by high altitude, diving, or by caisson disease, have been known to cause epistaxis. An additional cause is hemophilia. Various treatments have been recommended for epistaxis, varying in accordance with the cause and the severity of the condition. The upright position of the patient lowers the blood-pressure at the site of the hemorrhage and favors clotting. The time-honored remedy of placing ice on the back of the neck is probably chiefly of value in that it makes the patient hold very quiet to keep the ice in position. Of great importance is to have the patient breathe through the mouth and not to blow the nose in an effort to expel the clotted blood. Harmon Smith[1] says that adrenalin solution (1 : 1000) or hydrogen peroxide applications will stop mild hemorrhages. He also recommends fused silver nitrate, tannic and gallic acids, and compound alum powder. Occasionally rhinologists will be able to cauterize the bleeding point in the anterior

[1] Smith, Harmon: Keen's Surgery, 3, 412, 1926, W. B. Saunders Co.

nares. Hertzler and Chesky[1] recommend the cocainization of the ulcer and its cauterization with trichloracetic acid. Re-forming of the ulcer may be retarded or prevented by applying yellow oxide of mercury to the area. Cases which do not respond to these measures will require packing of the nose. The anterior nares may be packed by carefully and firmly inserting ½-inch salvaged gauze packing under a moderate amount of pressure (Fig. 76). A very useful appliance is the Simpson nasal tampon. This consists of a wedge-shaped piece of such material as to expand when subjected to moisture. It comes in various

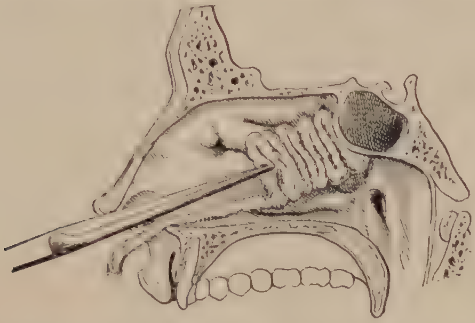

Fig. 76.—Packing of anterior nares. (Maisonnet, "Petite Chirurgie.")

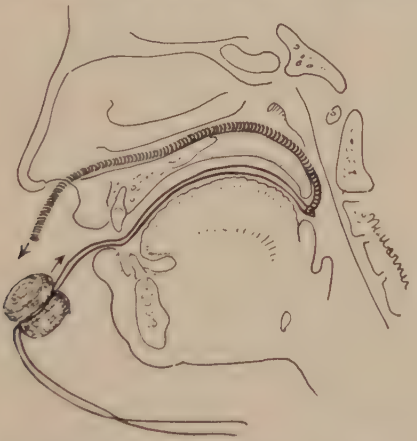

Fig. 77.—Packing of posterior nares. Soft-rubber catheter is introduced into the nostril until it appears in the pharynx. It is grasped by an instrument and drawn out through the mouth. A strong silk ligature is then attached to the tip of the catheter. A pledget of gauze is attached to the other end of the ligature at a distance of about a foot from the tip of the catheter. The catheter and ligature are then withdrawn from the nostril.

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[1] Hertzler, A. E., and Chesky, V. E.: Minor Surgery, C. V. Mosby Company, 1927, p. 145.

sizes. The blood in the nose will cause these tampons to swell up and tightly occlude the anterior nares. In some cases the bleeding point will be so far posterior that it will be impossible to control it by these measures and it will be necessary to pack the posterior nares. This is accomplished by passing a soft-rubber catheter into the nostril and down into the pharynx where it may be grasped and brought out through the mouth. Through the oral end of this catheter is then tied a strong silk ligature. To the other end of this ligature at a distance of some 12 inches is tied a pledget of gauze (Fig. 77). From this, in turn, is tied an additional 12 inches of silk ligature. The catheter and first silk ligature are then withdrawn from the nostril until the pledget is firmly pulled upward into the posterior nares. The pledget of gauze may be held tightly in position by tying the silk ligatures over another gauze pledget at the anterior nares (Hertzler) (Fig. 78). The distal ligature, which then protrudes from the mouth, is fastened for convenience to the proximal ligature which protrudes from the nose. When it is necessary to remove the pack it is done through the mouth by traction on the distal ligature. According to Moorhead[1] the best plan is to insert far into the nostril a rubber glove-finger or finger-cot and to inflate it with air or water (Fig. 79). Another method which seems rather homely, but which is apparently very effective,

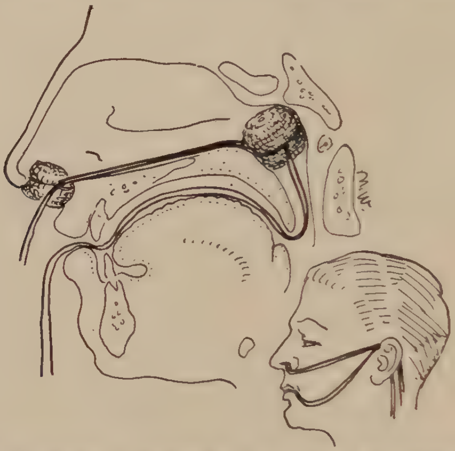

Fig. 78.—The silk ligature is drawn out of the nostril and traction is put upon it so that the gauze pack is forcibly applied to the bleeding area in the posterior nares. The traction is maintained by tying the ligature over a pledget of gauze at the nostril. A second silk ligature has been attached to the posterior pledget and is left hanging out of the mouth. When it is time to remove the pack, the removal is accomplished by traction on this ligature. The ligature ends may be hung over the ear for convenience.

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[1] Moorhead, J. J.: Traumatic Surgery, 2d ed., W. B. Saunders Co., 1923, p. 30.

is the use of salt pork.[1] The pieces of salt pork are kept in saturated solution of sodium chloride until their use is indicated in cases of severe nasal hemorrhage. The pieces of salt pork of appropriate size are inserted into the anterior nares so as to cover the bleeding point.

According to Webb[2] when the septum is anesthetized with cocaine and cleansed, a small clot may be found. Leading to this clot one often sees a vein larger than the rest—a sort of varicose vein of the nose—causing recurrent hemorrhages. When this vein is painted with phenol on a fine probe, the vein is destroyed, and the hemorrhages cease.

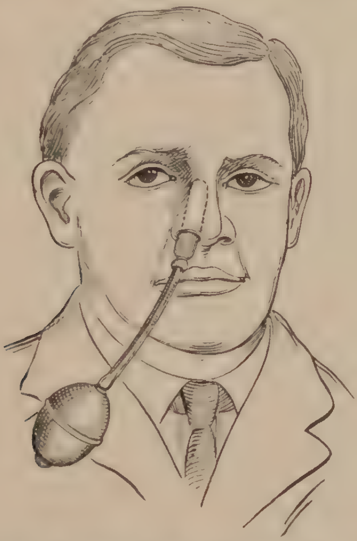

Fig. 79.—Epistaxis controlled by water or air inflation of a rubber finger-cot or glove finger. (From Moorhead, "Traumatic Surgery.")

4. **Hemorrhage from the Ears (Otorrhagia).**—Hemorrhage from the ear is caused by fractures of the base of the skull, injuries to the external auditory meatus, and by rupture of the tympanic membrane. It is also found in acute hemorrhagic otitis, granulations of the external auditory meatus, and malignant disease. In all cases where traumatism is suspected as being the cause it is of extreme importance to determine if possible if the blood in the external meatus has run in from the outside. It is often found that a scalp wound in the temporal region will cause considerable blood to run into the ear and if the ear be carefully cleansed, it will be found that the blood is merely in the outer part of the meatus and that the region of the tympanum is free of blood.

[1] Hurd, Lee M.: Arch. Otolaryng., 6, 447, November, 1927.

[2] Webb, R. C.: Personal communication.

If blood be demonstrated as arising from the tympanum in cases of traumatism of the head, it is a safe working rule to make a diagnosis of fracture of the base of the skull. Hemorrhage from the ear rarely is profuse enough to be troublesome. In those cases which are due to fractures of the skull, the best treatment is that directed to the underlying condition, namely, absolute rest and ice-bags to the head. The external auditory meatus is carefully cleansed with a sterile cotton applicator which has been moistened with boric solution. The auditory meatus is loosely plugged with sterile cotton. In cases where there is injury to the external auditory meatus alone, if the bleeding does not quickly subside spontaneously, a light pack of narrow-selvedged gauze may be put in place.

5. **Postoperative Tonsillar Hemorrhage.**—Tonsillar hemorrhage may occur primarily from inadequate ligation of bleeding vessels in the tonsillar fossa or secondarily from the avulsion of clots from the raw surface, which is brought about by the violent gagging efforts of the patient. A profuse hemorrhage may be instituted in this manner. It is particularly important to observe patients suspected of having tonsillar hemorrhage to see if they may be swallowing blood and giving a false impression of security because no blood is expectorated. The first warning in some of these cases is a copious emesis of swallowed blood. The treatment of tonsillar hemorrhage varies with the severity of the case. The milder cases are controlled by the application of an ice-collar and rest, which is aided by a hypodermic injection of morphine. The application of astringents, such as ferric chloride, compound alum powder, or coagulants, as "thromboplastin" and "fibrogen," frequently is of value to large areas of oozing raw surface. Direct pressure with a pledget of gauze on the end of the forceps or by means of a Mikulicz-Stoerk tonsil hemostat may be necessary. Where all such measures fail the patient should be taken to the operating room and with the aid of a good light and occasionally general anesthesia the bleeding points should be grasped with a hemostat and ligated. Occasionally ligation of the external carotid will be necessary.

6. **Hemorrhage from a tooth socket** may be controlled by packing the tooth socket with an excess of cotton or gauze, and then by tightly closing the jaws, causing firm pressure upon the pack (Fig. 80). The pack may be saturated with a coagulant, as "thromboplastin."

7. **Hemorrhage After the Use of Cautery.**—Severe secondary hemorrhage may occur after the use of surgical diathermy or the actual cautery in the treatment of neoplasms of the face. The separation of

the eschar which may occur some days after the operation may be accompanied by very profuse hemorrhage. Such hemorrhages must be treated as any other hemorrhage from wounds of the face, by pressure if possible, and ligatures if necessary.

8. **Factors Influencing Hemorrhage.**—Patients with high blood-pressure generally are subject to more profuse hemorrhage than those with low blood-pressure. Patients with jaundice and hemophilia, because of their diminished clotting powers, are subject to more profuse hemorrhage. In cases of high blood-pressure nothing can be accomplished to remedy this condition and not infrequently the hemorrhage if not too profuse may have a beneficial effect. In jaundiced cases the administration of calcium lactate and horse-serum should be tried. In hemophilia the use of proprietary "Fibrogen" (Merrill) has served a beneficial purpose. Blood transfusions will occasionally bring to the affected patient those coagulating properties of the blood which he lacks.

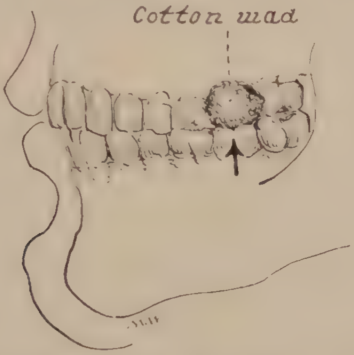

Fig. 80.—Control of hemorrhage after tooth extraction. An oversized cotton wad is firmly packed into the tooth socket and tight pressure by the lower jaw retards the bleeding.

III. FRACTURES AND DISLOCATIONS INVOLVING THE HEAD

1. **Fractures of the Nose.**—The most common fracture of the face is the broken nose. Fractures of the nasal bones are of far more serious significance than the mere facial disfigurement indicates. The nasal bones are attached to the perpendicular plate of the ethmoid, the vomer, the cartilaginous septum, the superior maxilla, and the frontal bone. Most of these fractures are compound, either the skin or the mucous membrane being injured. Resulting infections may be the cause of abscesses, osteomyelitis, or liquefaction of cartilage. Displacement of the nasal bone or of the septum may bring about serious

impairment of the nasal air-passages. The diagnosis is generally made by swelling, tenderness, and crepitus. The matter is best elicited by the most gentle palpation. The aim of treatment is the restoration of the parts to their normal anatomical positions. This means restoration of the nasal passages to insure good breathing space and also restoration of the outer conformity of the nose. In most cases the former of these two requirements will be the more important. The author believes that the treatment of the broken nose is best undertaken by the well-trained otolaryngologist. If such be unavailable the anterior nares should be carefully cleansed of adherent blood-clots and washed out with a mild antiseptic solution, such as boric acid or dilute mercurochrome. If a wound be present on the outside of the nose this likewise should be cleansed and treated with a mild antiseptic. It is then generally advisable to anesthetize the patient and to insert in each nostril a small curved artery-forceps, periosteal elevators, or urethral sound, and by manipulation of this, together with palpation of the outer parts of the nose, an effort is made to restore the broken fragments to their normal position.

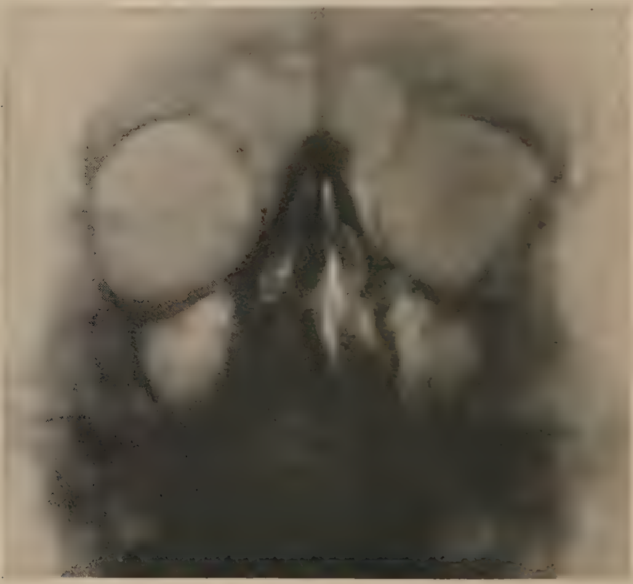

Fig. 81.—Fracture of malar bone. The orbit was narrowed in this case, and diplopia and some exophthalmos were present. No attempt at reduction was made and the diplopia disappeared after several weeks.

Where there is a tendency for the deformity to recur, an external splint with forehead attachment or internal packing or an "Asch tube" should be employed. Salinger[1] attaches his splint to a plaster head-cast. The nasal cavity should be cleansed three times daily with an antiseptic wash.

Blows upon the face may *fracture the orbital plate* (see Orbital Pneumatocele) or the malar process in such a manner as to permit passage of air from the frontal sinus to the orbital tissues. The writer recalls a case of a young man who, shortly after a boxing match in which he was struck on the face, blew his nose and to his astonishment created a large area of orbital subcutaneous emphysema. A second effort to blow the nose merely increased the size of this emphysema. The air which is so injected under the skin will readily absorb without active treatment.

2. **Fractures of the malar bone** are caused by blows upon the side of the face. There is generally a depression on the side of the face and below the eye. The displaced fragment may interfere with the movement of the coronoid process of the inferior maxilla and thus cause limitation of the movements of the jaw. The mesial displacement of the malar bone will cause a narrowing of the orbit with the result that the eye is slightly protruded and diplopia results (see Fig. 81 for x-ray in such a case). Scudder[2] has given us directions for making an examination for fractures of the malar bone.

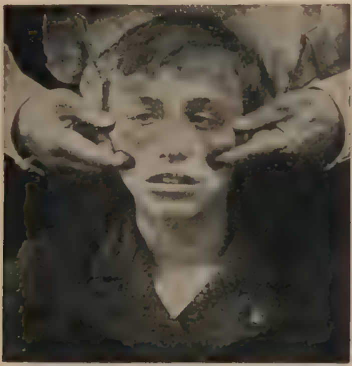

Fig. 82.—Proper position from which to palpate the malar bones. The fingers touch the inferior borders, the thumbs the posterior borders, of the malar bones. (From Scudder, "Treatment of Fractures.")

"Palpation of the malar bone is somewhat difficult. The best method of doing it is to stand behind the sitting patient (Fig. 82) and to feel both malar bones at the same time—the left one with the left hand and the right one with the right hand. The malar process of the superior maxilla is felt inferiorly by pushing the skin of the cheek upward. The orbital part of this process is felt superiorly at the middle of the inferior border of the orbit. Following the orbital margin outward and upward, the orbital border is palpated up to the frontal process. Following the malar process of the superior maxilla backward, the free inferior border of the malar is felt continuous backward with the zygomatic process. Starting on the frontal process, the posterior border of the malar may be palpated downward and backward to the upper border of the zygomatic process of the temporal bone. The inferior surface of the malar may be felt by placing the fingers, palm downward, in the upper sulcus of the cheek and following backward until the coronoid process of the lower jaw is felt. In the case of a fracture that is as often unrecognized as is this one, it is important to be very familiar with the details of the outline of the bone."

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[1] Salinger, S.: Illinois Med. Jour., 1925, 48, 304.

[2] Scudder, C. L.: Treatment of Fractures, 10th ed., p. 69, W. B. Saunders Co., 1927.

The lesser displacements of the malar bone will not require treatment. Even when diplopia be present, the eye muscles will compensate for the changed requirements and single vision will be restored after three or four weeks. Interference with the coronoid will require treatment. Before cutting operations are resorted to an attempt should be made with a blunt instrument to raise the fragment from inside the mouth. Codman grasps the fragment by means of a blunt double hook through the skin. Where these methods fail, a small incision should be made and the fragment raised by means of a hook or screw elevator. Great care should be exercised so as not to inadvertently force the fragment into the orbit and injure the eye. It is often surprising how inconspicuous a small depression on the side of the face will be and open treatment should only be undertaken after serious consideration.

3. **Fractures involving sinuses** are potentially the cause of infection which may proceed from the sinus itself to the adjacent soft parts.

4. **Blows upon the zygomatic process** may cause a depression of this bone and it will be necessary to elevate the depressed fragment by means of a small hook inserted in a small wound made under local anesthesia.

5. **Fractures of the superior maxilla and of the mandible** scarcely belong to the field of minor surgery and their treatment falls into the hands of the oral surgeon and dentist. The first-aid treatment of fractures of the mandible is a four-tail bandage placed over the point of the jaw, which is fastened tightly over the head to hold the fragments in place (Fig. 83). The patient is then referred to the dentist who, by

means of wiring, will attach the lower jaw to the upper jaw and hold the fractured mandible stationary until healing is brought about.

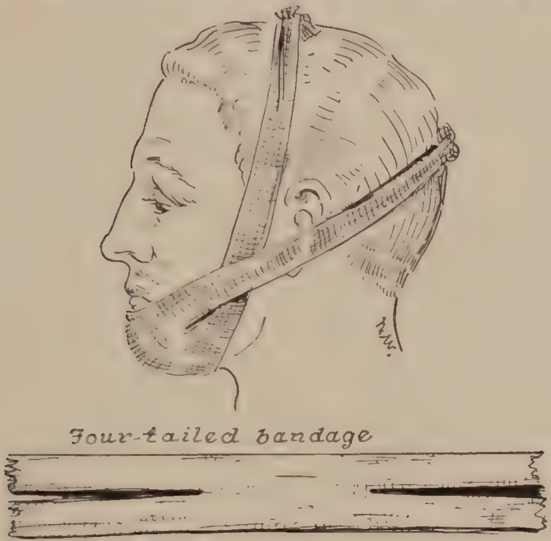

Fig. 83.—Four-tailed bandage used in the first-aid treatment of fractures of the mandible.

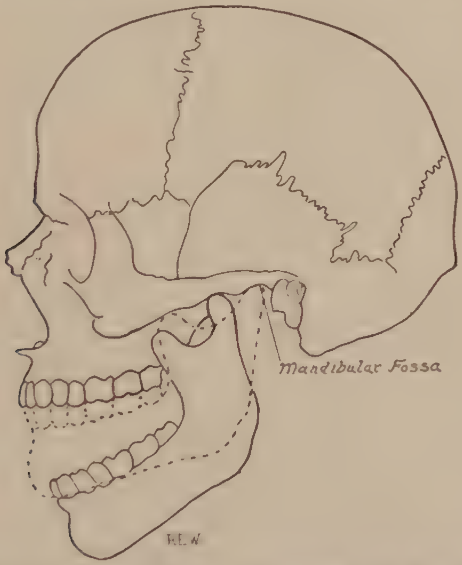

Fig. 84.—Diagram showing dislocation of the mandible.

Blows upon the mouth which loosen teeth will cause momentarily a profuse hemorrhage. This is rarely of long duration. It is extremely advisable to try to preserve these teeth. If they are loose, they should not be extracted, and if they are bent out of position an effort should be made to straighten them. The counsel of a dentist is indicated.

6. **Dislocation of the lower jaw** is practically always forward and may be unilateral or bilateral (Fig. 84). The cause may be muscle action alone or a force applied to the widely opened jaw. The accident commonly occurs during the extraction of teeth, when a very large object is placed into the mouth, or during yawning, coughing, or laughing. The condyle being already advanced forward, the pull of the external pterygoid and possibly the temporal muscles will bring about the dislocation. This dislocation may be very difficult to reduce. Cotton[1] describes two methods of treatment. The first is the leverage-depression of the angle of the jaw with raising of the chin. "The best way of doing it is to put the two thumbs (protected with a twist of gauze or with heavy thumb-cots) in either side of the mouth, to the outer side of the last molar teeth (Fig. 85). Then sharp pressure is thrown upon these teeth—down and backward—and the operator's fingers lift the chin at the instant he slips his thumbs outward into the cheek. The jaw goes back with a snap" (Cotton). The other method is carried out by depressing the chin as far as it will go, and then with

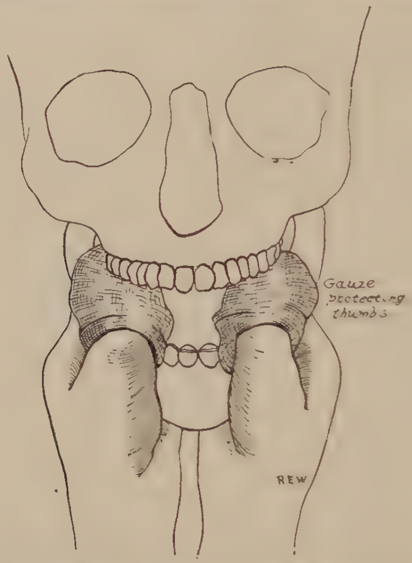

Fig. 85.—Diagram showing method of reduction of a dislocation of the mandible. The thumbs are protected by gauze and the mandible is grasped between the thumb and fingers. Steady downward and backward pressure will usually reduce the dislocation. (See text.)

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[1] Cotton, Frederic, J.: Dislocations and Joint Fractures, 2d ed., W. B. Saunders Co., 1924, p. 72.

the thumbs on the inside or the outside of the mouth, thrusting the jaw backward without great force. Anesthesia may be necessary. After reduction the mouth should not be opened too widely for a week or two. Certain cases require operative intervention. A case has been reported of reduction after ninety-eight days without incision (Cotton).

7. **Skull Fractures and Brain Injuries.**—The majority of *injuries involving the brain* and the *skull* may properly be included in the domain of minor surgery. All gradations of concussion of the brain from the momentary loss of consciousness of the football player or the boxer, to the profound coma of the severe injury are treated by the simple measures of rest and cold applications to the head. Whereas the actual treatment of these conditions may be extremely simple, the observation of the progress of the case may require a considerable degree of intelligence and of experience. The activating principle in the observation of these cases is to so estimate the condition of the patient as to be able to determine when major surgery is indicated. By major surgery is meant a subtemporal decompression or the possible removal of a bone flap. The presence or absence of a fracture of the skull is of subordinate importance as compared to the injury to the brain itself. Severe injury to the brain with lacerations of the brain substance and permanent injury may occur without any solution of continuity of the skull itself. On the other hand, extensive linear fractures of the vault of the skull may occur without loss of consciousness and without appreciable symptoms. All cases of traumatism of the head, whether the skull be fractured or not, should be regarded as potentially serious. In but few cases, however, will surgical intervention be required. Certain types of fractures of the skull from the outset belong to the province of major surgery, and these are the cases of depressed fractures of the skull, crushing fractures of the skull with loss of brain substance, and fractures of the skull in which foreign bodies have entered the cranium. Children, as a rule, tolerate severe cranial injuries better than adults.[1]

A serviceable routine for the treatment of head injuries may be outlined in the following:

The patient should first be placed at absolute rest in the dorsal position. The room should be kept absolutely quiet and conversation prohibited or reduced to a minimum. It will be better to have the room darkened. Ice-bags should be placed to the head. The nurse or attendant should be instructed to observe the state of the patient's consciousness, the presence or absence of vomiting, and should take the pulse and respiration every fifteen minutes. The blood-pressure should be taken at intervals of two to three hours. If the repeated observations of the pulse-rate show that the pulse-rate is decreasing (bradycardia) increase of intracranial pressure may be suspected. If vomiting occurs, particularly of the projectile type, further evidence of increased intracranial pressure is obtained. An increase in the blood-pressure may be interpreted as a systemic effort to overcome the increased intracranial pressure which acts as a deterrent to the entrance of arterial blood into the cranium. The eye-grounds should be examined for evidence of "choked disk" (papillary edema), an evidence of increased intracranial tension.

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[1] Beekman, F.: Ann. Surg., 1928, 87, 355.

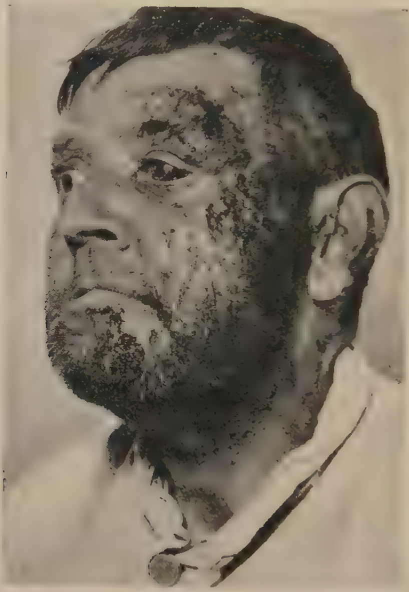

Fig. 86.—Subconjunctival hemorrhage in skull fracture. Multiple lacerated wounds.

As a routine the cranial orifices should be carefully examined. The presence of hemorrhage from one or both ears is practically pathognomonic of fracture of the base of the skull. Hemorrhage from the nose or mouth may occur in fractures of the base of the skull. Unilateral or bilateral subconjunctival ecchymoses (Fig. 86) or bilateral symmetrical orbital ecchymoses, particularly those occurring some days after the accident, will suggest fracture of the base of the skull. In patients who are unconscious and in whom the *x*-ray is negative it will occasionally be advisable to do a lumbar puncture to determine whether or not there is free blood in the spinal fluid. If the lumbar puncture needle encounters a vessel on its introduction, blood will appear on the first drainage from the needle, but this may rapidly disappear if there is no blood in the spinal fluid itself. Many surgeons believe that the reduction in the spinal-fluid pressure which is effected by the withdrawal of a certain amount of spinal fluid has a beneficial effect upon the increased intracranial pressure. This withdrawal is best accomplished by the use of the spinal puncture needle and manometer devised by Dr. Harry Jackson.[1] The needle is inserted in the usual manner into the spinal canal and is so connected with a mercury manometer that the degree of pressure of the spinal fluid may be measured. If this be over 7 or 8 mm. of mercury, it will be well to allow a certain amount of fluid to escape by using the lateral stopcock of the spinal puncture needle. This must not be done too rapidly because of the danger of compression of the medulla attending too sudden withdrawal of spinal fluid. In cases of increased intracranial pressure the brainstem may be forced into the foramen magnum with this release of the spinal-fluid pressure and sudden death may result. At the outset of such withdrawal of the spinal fluid it is not uncommon to find the pressure 30 or 40 mm. of mercury. This may be gradually reduced to the normal pressure. The whole process may be repeated several times if thought indicated. Certain neurologists and others attach but little weight to this method of treatment of increased intracranial pressure because they believe that the spinal fluid is too rapidly reformed to have the pressure substantially lowered. Their recommendation is the administration of hypertonic solutions intravenously; for this purpose 20 to 30 c.c. of 50 per cent. glucose solution will be advisable. The presence of a strongly hypertonic solution from the blood-stream will have the effect of extracting the excess fluid from the edematous contused tissues and the edema of the brain, which has resulted from the blow upon the head, will be relieved. This measure has certainly been found to be very beneficial and should be used in all cases of this type. Dehydration with magnesium sulphate administered either by mouth or by rectum is valuable in compression cases.[2]

The attendant should be instructed to watch particularly for any localized twitchings or seizures, such as jacksonian epilepsy involving the hand or foot. This would indicate localized cortical pressure and might indicate a craniotomy. In uncomplicated cases of skull fracture it will be advisable to keep the patient in bed for three to four weeks with restricted mental activity. Moreover, he should be kept relatively quiet for a period of two to three months afterward.

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[1] Jackson, Harry: Jour. Amer. Med. Assoc., vol. 79, October 21, 1922.

[2] Rand, C. W., and Nielson, J. M.: Arch. Surg., 11, 434, September, 1925.

8. **Orbital Pneumatocele.**—Blows upon the face may cause a fracture of the orbital plates in such a fashion as to communicate with a sinus. Following this accident violent blowing of the nose will force air into the subcutaneous tissues of the orbit. The air will readily absorb and no other treatment is required beyond abstinence from blowing the nose.

9. **Broken and Necrotic Teeth.**—These generally will require the services of a dentist, but in the absence of such, necrotic teeth may be extracted under nitrous oxide or after the infiltration of the tooth socket with local anesthesia. Care must be taken to remove all the roots. Broken teeth may be repaired by the dentist.

10. **Piercing Ears for Earrings.**—This almost obsolete procedure is still occasionally requested. A straight cutting needle is passed through the ear and after it is drawn the silk thread which had been threaded through the needle. The thread is moved daily until the tract through which it is passed has become epithelized and it is then withdrawn. Needless to say these procedures are carried out under strict antiseptic and aseptic precautions. Local anesthesia may be employed.

FIRST AID IN MAJOR SURGICAL INJURIES OF THE HEAD

The essentials in the first-aid treatment of severe injuries of the head are the minimization of the introduction of infection into the wound, the treatment of shock, and the intelligent and careful transportation of the patient to the hospital. In large depressed fractures of the skull with escape of brain substance, energetic cleansing efforts are to be avoided. The application of a mild antiseptic of mercurochrome and a protective dressing is all that is required.

If shock be present it will be best to treat the patient with appropriate antishock remedies before any drastic transportation is attempted. In severe wounds of the eyes and perforation of the chambers, mercurochrome installations and application of a sterile bandage will be the proper first-aid treatment, until the patient may be placed in the hands of an ophthalmologist. Avulsion of the scalp and severe lacerations of the ears should be treated with the application of an antiseptic and a sterile dressing pending arrival at the hospital.

CHAPTER IX

INFECTIONS OF THE HEAD

Inflammation of tissues is the reaction of the tissues to any type of invasion. The most common type of invasion is that of pathogenic bacteria. Inflammation, however, may be caused by sterile irritants such as turpentine or chemicals. It may also be caused by extremes of temperature.

The scalp is composed of five layers (Piersol) (Fig. 87). The first layer is the skin which is the thickest portion of the integument of the body. Immediately beneath the skin is the superficial fascia, and beneath it, the occipitofrontalis muscle and its aponeurosis. These three layers are so intimately attached that they may be considered as one. The superficial fascia consists of "a network of connective-tissue fibers which run from the skin above to the aponeurosis of the occipitofrontalis below" (G. G. Davis). In this fascia may be found little shot-like masses of fat, blood-vessels, nerves, and lymphatics. This area is extremely vascular. The anatomical structure is thought to retard swelling in superficial infections of the scalp, and to favor limitation of suppuration. The fibrous trabeculæ prevent lateral extension. The next layer to be encountered is the subaponeurotic connective tissue. This loose thin layer lies between the pericranium and the aponeurosis of the occipitofrontalis. Its texture permits the "movements" of the scalp of the layers above it. Infection or effusion of blood in this layer or space may spread laterally without difficulty. The limits of this spread may be posteriorly to the superior curved line of the occipital bone, anteriorly to a little above the eyebrows, and laterally to a level somewhat above the zygoma (Piersol). Suppuration in this layer may spread to the meninges. The lowest layer

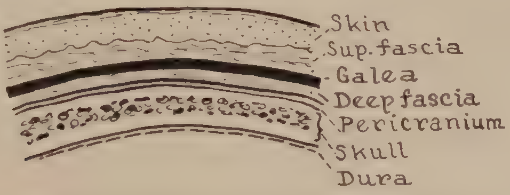

Fig. 87.—Diagram showing the layers of the scalp.

of the scalp is the pericranium, or periosteum of the skull. "Subpericranial effusions of blood, or collections of pus, are limited and outlined by the lines of the sutures" (Piersol).

I. INFECTIONS OF THE SCALP AND THE SKULL

(*a*) **Cellulitis.**—Diffuse inflammation of the scalp is spoken of as cellulitis. In this condition there is no centralized infection or localized process, but the bacterial invasion and its inflammatory response are diffuse. Cellulitis is the result of infection through some minute portal of entry which may, however, be so small as to be invisible. The infection may involve only the most superficial layers of the skin and its rapid spread may be through the lymphatics. Or the infection may involve the superficial fascia where lateral spread is less likely to occur. Where wounds penetrate the aponeurosis, the subaponeurotic space is involved and lateral spread of infection may take place. The treatment of cellulitis of the scalp rests in cleansing of the area with an antiseptic wash, as boric solution or mercurochrome, and the industrious application of hot fomentations, preferably of boric acid solution. It is usually unnecessary to clip or shave the hair in mild cases of cellulitis of the scalp. Where, however, the infection seems to be spreading despite treatment and where it is of a particularly virulent type, it will be safer to clip and shave the affected area.

(*b*) **Furuncle.**—Localized cutaneous infections of the scalp which are well circumscribed and have a central cavity containing pus are known as furuncles. These furuncles may be of various sizes. When very small and in the incipient stage a prophylactic treatment, which often brings success, is to give the furuncle two or three coats of 7 per cent. tincture of iodine, allowing the solution to dry between applications. Well-developed furuncles are best treated by continuous fomentations. For this purpose a large pack of gauze saturated with boric solution and kept warm is the most useful. Where expediency prevents the utilization of this method the treatment by a softening unguent is to be recommended. The central cauterization of the furuncle with phenol on a small applicator, a toothpick, or a probe, is a method which, in the hands of some, has given excellent results. It will be advisable in practically all cases to clip the hair over and in the neighborhood of the furuncle. It is desirable to have the furuncle rupture spontaneously. If, however, there is definite fluctuation or "head," incision with a very sharp, lancet-pointed knife is permissible. Under no circumstances should the affected area be subjected to squeezing or pressure. Particular care must be observed in the prevention of the spreading about of pus on the uninfected skin. The discharge from the furuncle will contain abundant numbers of staphylococci which, if implanted in hair follicles, may give rise to further furuncles. Some authorities employ an antiseptic unguent, such as gray ointment (unguentum cinereum). In chronic cases of recurrent furunculosis of the scalp, an autogenous vaccine made from cultures of the patient's furuncles will be beneficial in about 50 per cent. of the cases. The use of tin and *x*-ray may be tried (see chapter on Boils and Furuncles).

Furunculosis of the External Auditory Meatus.—According to Ballenger,[1] the early use of a 5 per cent. solution of carbolic acid in glycerin will occasionally abort early furuncles of the external auditory meatus. In the early inflamed stage of furunculosis, the loose packing of the canal with small strips of gauze moistened with a 4 to 8 per cent. solution of aluminum acetate is valuable. When there is definite pus present, the furunculous area should freely be incised with a narrow bistoury.

(*c*) **Carbuncles of the scalp** must be treated with great care and, for the first twenty-four hours at least, one is more inclined to use conservative measures such as fomentations and unguents than to incise. If, however, the process is increasing, it will be necessary to treat the condition surgically. For this purpose a crucial or sexangular incision with undercutting of the flaps and loose packing of the cavity will be necessary (see chapter on Boils and Carbuncles).

(*d*) **Subpericranial Abscess.**—Occasionally pus will develop beneath the galea aponeurotica or beneath the pericranium. Because of the toughness of the overlying layer, fluctuation will be difficult to demonstrate. If the condition be suspected by virtue of the swelling, pain, pulse, and temperature, free incision and drainage are indicated. Counter-drainage may be necessary at the dependent portions of the scalp. If this condition be not recognized promptly and accorded proper treatment, osteomyelitis of the skull may result.

(*e*) **Herpes, Impetigo, and Ringworm.**—The surgeon will often be invited to treat non-surgical dermatological conditions of the scalp and it will be necessary for him to be able to make a differential diagnosis of the commoner skin ailments.

Ringworm of the Scalp (Tinea Tonsurans).—Ringworm of the scalp is primarily a disease of children. The ordinary form is characterized by dime- to half-dollar-sized gray patches covered with a slight scale in which can be seen the broken-off stumps of hairs. This type in no way resembles a carbuncle. The ringworm lesion, however, which may be confused with a carbuncle, is the moist boggy furuncular type known as "kerion." This type generally is characterized by a single patch, circular in outline, definitely elevated, and boggy in consistency. Pressure upon it will cause pus to exude from the infected hair follicles. The lesion is a conglomerate, pustular folliculitis produced by the ringworm fungus (ectothrix variety). Symptomatically, pain is not a predominate feature, although the cervical lymph-nodes may be enlarged and tender. The treatment is *not* surgical incision. The hair around the swelling should be shaved, and hot boric fomentations applied. The loose hairs should be removed with a forceps, and the part painted daily with tincture of iodine, or applications should be made of a 5 per cent. white precipitate ointment.

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[1] Ballenger, W. L. and H. C.: Diseases of the Nose, Throat, and Ear, p. 675.

Impetigo.—The type of impetigo commonly seen upon the scalp is a follicular one known as "Bockhart's impetigo." This is a superficial suppuration which may occur on any of the hairy portions of the body and commonly on the scalp. It may arise without apparent cause or it may follow the irritation produced by strong drugs.[1] The lesion is a hair follicle infection, purulent from the start, each lesion perforated by the shaft of a hair and caused by the Staphylococcus aureus. The condition may be limited to a single portion of the scalp, or it may involve it quite generally. The condition is often a chronic one. The treatment consists of hot boric fomentations followed by applications of a 5 per cent. white precipitate ointment (unguentum hydrargyri ammoniati).

Herpes zoster is commonly seen involving one side of the scalp. The onset is generally preceded by some neuralgic pain and for a day or two may present some difficulty in diagnosis. Herpes zoster on the scalp is generally the result of an irritative lesion of the posterior root ganglion of the trigeminal nerve. The eruption manifests itself often as isolated groups of flat papules becoming vesicular in a few days. It is attended by some pain and is limited definitely to one side of the scalp by the median line. The diagnosis is easy when the eruption extends onto the glaborous skin, but when the scalp alone is involved, it may be rather difficult. Depending upon the nerve involved, the disease may occupy the vertex, the occipital portion of the scalp, or it may extend down into the supra-orbital region. In this case the eye may be the seat of iritis, choroiditis, or retinitis, and extensive damage to the eye may result. The treatment consists in easing the pain, the prevention, if possible, of secondary infection, and the support of the strength of the patient. For this purpose probably nothing is better than hot boric fomentations followed by the use of soothing antiseptic lotions. An example of the latter is[1]:

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[1] MacKenna, R. W.: Diseases of the Skin, Williams & Wilkins, Baltimore, 1927.

Zinci oxidi	12
Talcum	8
Glycerin	6
Phenol	2
Liquor calcis	120
Aquæ rosæ, q. s. ad	240

For the relief of pain aspirin or sodium salicylate should be given in fairly large doses.

(*f*) **Osteomyelitis of the skull** may result from infections of the scalp (rarely), or from wounds of the skull itself, as puncture wounds of compound fractures. It may also occur from infected wounds involving the subaponeurotic connective tissue. As indicated above, an abscess forming beneath the aponeurosis may cause osteomyelitis of the skull. Acute abscesses should be incised down to the bone and ample drainage should be provided. The dressings should be arranged so that the discharge from the wound is not spread on the adjacent region. The wound itself should not be probed for the presence of a sequestrum. The latter most frequently will discharge itself spontaneously. If this does not occur and its presence is suspected, *x*-ray examination will often reveal it. And if it seems to be detached from the neighboring bone, a sequestrectomy will be indicated. Cushing says that all of the diseased bone should be rongeured away to undoubtedly healthy bone.

(*g*) **Syphilis of the Skull.**—Gummatous inflammation originating in the pericranium may spread widely in the diploë and bring about a syphilitic osteitis, and cause the skull to present a worm-eaten appearance. When the gummata become infected and break down, the skull is affected so that there is considerable area of necrosis and sequestrum formation.

The treatment of cranial syphilis will be antiluetic medication and surgical drainage of the infected area. Sequestrectomy may occasionally be necessary.

(*h*) **Tuberculosis of the Skull.**—In describing tuberculosis of the skull Cushing[2] says that "it occurs almost without exception in children, usually as a single circumscribed lesion of the vault; more rarely there are multiple ones. Concomitant foci of tuberculosis elsewhere in the body commonly serve as a tell-tale of the nature of the process.

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[1] Oliver, Edward A.: Personal communication.

[2] Cushing, H.: Keen's Surgery, 3, 51, 1926, W. B. Saunders Co.

The disease usually starts in the diploë, and the focus of suppuration quickly extends in the child's thick skull, both externally and internally, and leads to the perforating abscess described by Virchow. The subperiosteal 'cold' abscess—soft, fluctuating, covered by reddened skin—frequently opens itself leaving a sinus, at the bottom of which a patch of necrosed bone may be detected. A small sequestrum usually forms, separates early, and may be removed by curettement. The disease often remains limited to the external table. When neglected, these tuberculous abscesses may burrow under the pericranium or aponeurosis and open at a distance, leaving fistulous tracts which are difficult to heal unless widely laid open, thoroughly cleansed and packed. The temporal bone is the most common seat of tuberculous osteitis, the process being secondary to tuberculous otitis media or mastoiditis. . . ."

II. INFECTIONS OF THE FACE

The general rules which apply to the diagnosis and treatment of cellulitis, furuncles, and carbuncles, which were outlined in Chapter IV, apply with certain exceptions to those conditions on the face. However, all infections of the face are more serious than in any other region of the skin because of the communications of the inferior and superior angular veins to the cavernous sinus. Infections involving these veins may be a kind of retrograde thrombosis affecting the cavernous sinus, with fatal results (see chapter on Furuncles and Carbuncles).

Incision into infections of the face is undertaken far less readily than in any other situation. All such infections should be treated primarily by hot fomentations. It is very difficult to have such hot fomentations properly applied without very specific directions and without the aid of an attendant or nurse. In furuncles and carbuncles of the upper lip it will be advisable to place a large pack of gauze saturated with boric solution over the area and surrounding parts. The common error is to make such packs too small. If the furuncle be on the upper lip the pack should extend over the eye on the affected side, below the chin to the anterior margin of the ear, and over the mouth and nose, leaving only a corner of the mouth exposed for breathing (Fig. 88). These packs should be changed every fifteen minutes if possible or, what is more efficient, they should be covered with a waterproof material, as rubber sheeting or oil silk, and over this an electric pad should be fastened in place so that continuous moist heat is secured.

Furuncles of the nose deserve the same degree of conservative care. These small infections in the alæ nasi are extremely painful because of their proximity to the cartilaginous plates of the nose. The patient is greatly tempted and often does squeeze these infections in the effort to express pus with the result that the infection is widely disseminated even to the extent of a fatal result (see chapter on Boils and Furuncles). The best treatment is that of continuous hot fomentations. Should this be inexpedient, however, it will be advisable to carefully place in the nostril white vaselin or unguentum hydrargyri

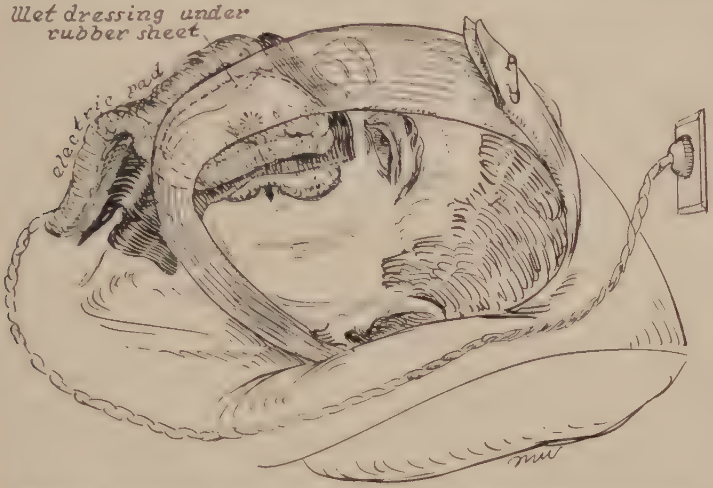

Fig. 88.—The technic of hot boric fomentations in a furuncle of the upper lip. A large-sized gauze pack, saturated with boric solution, is placed over the cheek, mouth, and nose. Only a small corner of the mouth is left open to permit breathing. The gauze pack is covered with rubber sheeting and an electric pad is placed on top. The gauze, sheeting, and electric pad are held in place by a pinned towel.

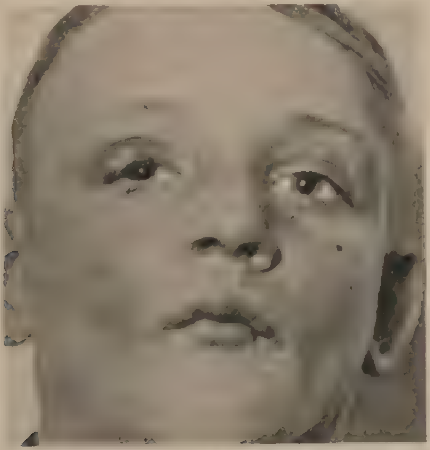

Fig. 89.—Hordeolum (stye). (Children's Memorial Hospital, Chicago. Service of Dr. Richard Gamble.)

ammoniati in an effort to facilitate and hasten discharge of the furuncle into the nostril. Furuncles of the external auditory meatus are extremely difficult to treat by fomentations. However, they may serve some benefit.

The **stye or hordeolum** is a localized staphylococcus infection or abscess of the lid margin, which originates in one of the sebaceous follicles of the lashes (Fig. 89). Cold compresses will occasionally abort a stye. When it is evident that the stye cannot be aborted, hot compresses are useful to hasten the suppuration. As soon as a yellow spot is seen, "the pus should be evacuated either by pulling out a lash, or by horizontal incision and then squeezed out."[1] One-half per cent. yellow oxide of mercury ointment rubbed into the lid margin with a cotton applicator is often a very valuable prophylactic agent and useful remedy in the treatment of early styes. All patients suffering with styes should be referred to an ophthalmologist for examination. Errors in refraction are believed to have an etiological bearing upon styes. The exhibition of tin or calcium sulphide internally may be indicated.

Acute Dacrocystitis.—A stye should not be confused with an acute dacrocystitis or inflammation of the lacrimal sac. The latter condition is manifested by a tender red swelling of the skin over the lacrimal sac. When, after two or three days, an abscess has formed, it is opened by a free incision pointing downward and outward. The incision is loosely packed with gauze. Incomplete healing will occasionally bring about the existence of a lacrimal fistula. In some cases it is advisable to extirpate the sac, but never until the acute symptoms have entirely subsided (see May, C. H., Diseases of the Eye, p. 75, William Wood & Co.). Rinz[2] reports a case of gangrenous peridacrocystitis.

Erysipelas is a cutaneous infection due to the streptococci which tend to spread through the lymphatic system. It is particularly common upon the face. It will not develop without the presence of a small wound, which, however, may be so small as to be invisible. It may originate from the picking of a small pimple on the face or in the corners of the nostril. The initial symptom is usually a chill. The patient has an unusual elevation of temperature, 103° or 104° F., a marked degree of prostration. The involved area spreads laterally with a sharply demarcated, wavy, and slightly elevated border. The average duration of the disease is two weeks and exacerbations are frequent. Because of the infectious nature of this ailment, it is always to be treated by isolation of the patient and the observance of antiseptic precautions on the part of the attendants. Numerous forms of treatment have been recommended and these vary somewhat according to the type of case involved. The patient will be put to bed at complete rest with a very bland diet and the pushing of fluid.

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[1] May, C. H.: Diseases of the Eye, 8th ed., William Wood & Co., 1914, p. 43.

[2] Rinz, R. DeC.: Med. ibera, 12, 287, 1928.

The local applications which are most suitable are cold solutions. Of these, iced boric solution is probably the best. Ichthyol ointment (10 per cent.) has warm advocates. The painting of non-flexible trenches to the advance of the spreading infection has been recommended, but is not frequently successful. Of recent years great encouragement has been reported following the use of antistreptococcic erysipelas serum (see p. 50, Chapter VIII). *x*-Ray has also been useful (see p. 50).

By the term "phlegmonous erysipelas" is meant those very virulent types of erysipelas infection which involve the entire thickness of the skin. These infections result in necrosis and are extremely dangerous. The treatment which belongs to the domain of major surgery is debatable. Most surgeons somewhat reluctantly employ multiple free incisions preferably by the actual cautery.

Erysipelas of the scalp is a spreading cutaneous streptococcic infection, accompanied by elevation of temperature and extreme systemic prostration. The elevation of the border and the sharp demarcation are less evident in the scalp than elsewhere in the body. The presence of erysipelas which has originated in the hairy scalp may not be evident until, as Cushing says, its red skirmish line comes "into the open" on the forehead. The treatment does not require the shaving of the affected area. Cold boric applications or 10 per cent. ichthyol ointment combined with antistreptococcic erysipelas serum offer the best measures for relief. The disease usually lasts from seven to nine days on the scalp.

Otitis Media.—Infections of the middle ear, which are particularly prevalent in children and are characterized by pre-existing or coincidental respiratory infections, elevation of temperature, pain in the ear, and a bulging, red tympanum, will require a paracentesis. Early incision of the tympanic membrane will often avert inflammation of the mastoid.

According to Ballenger[1] "incision of the membrana tympani is an almost ideal therapeutic measure in the early or preperforative stage of acute suppurative otitis media, though it is of less value in the later stages of the disease, and in the chronic type. In such cases the establishment of free drainage and the total removal of the morbid material should be accomplished. In acute cases the incision of the membrana tympani should be long and curved, to permit the secretions to flow through it." The operation should be performed as soon as there is bulging of the tympanic membrane. The external auditory canal should be cleansed with 1 : 4000 bichloride solution before the puncture. Partial anesthesia may be obtained by dropping 2 or 3 drops of a solution composed of equal parts of hydrochlorate of cocaine, menthol, and carbolic acid into the auditory meatus. General anesthesia may be indicated. The best instrument is a curved bistoury. The simple puncture is inadequate, but a long curved incision is proper and should be made in the postero-inferior quadrant (Fig. 90). After the incision has been made, the canal should be loosely packed with gauze two or three times daily until the discharge ceases.

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[1] Ballenger, W. L. and H. C.: Diseases of the Nose, Throat, and Ear, 5th ed., Lea & Febiger, p. 789.

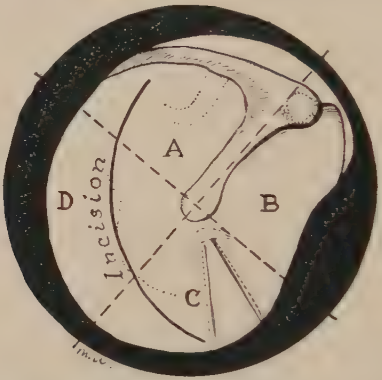

Fig. 90.—Diagram of tympanum showing landmarks and most favorable site for paracentesis. (After Ballenger.)

Peritonsillar Abscess; "Quinsy."—Some cases of tonsillitis are complicated by the formation of an abscess in the connective tissue adjacent to the tonsil. There is fever, and marked prostration is present. The diagnosis may be made by the extreme pain in this region which radiates to the ear, by the difficulty in swallowing, and by the red, bulging prominence generally in the soft palate above the tonsil. A gentle palpation may demonstrate fluctuation. Inasmuch as early manipulations are dangerous, the incision of these had best be deferred until there is reasonable assurance that free pus has developed—generally thirty-six to forty-eight hours. A sharp-pointed knife is used and is so covered with adhesive tape that but $\frac{1}{4}$ inch of the knife projects beyond the adhesive covering (Figs. 91, 92). The abscess is opened with a downward stroke of the knife and is generally followed by marked relief. Hot throat irrigations (soda bicarbonate, 1 dram to 1 quart of water) are useful in allaying pain until incision is made. A hot saline irrigation with a crooked glass tube is very comforting.

Numerous types of fatal consequences have resulted from peritonsillar abscesses and, of late, writers have been prone to recommend earlier incision. Greenfield[1] says that an appreciable amount of pus is usually present on the third day. This author employs a vertical incision over the point of maximum swelling. Stenger[2] advises prolonged expectant treatment and describes a special type of incision. The tonsil is separated from the palatal arch until the posterior surface of the tonsil is reached, a maneuver which usually causes the abscess to open itself. Nagel[3] advises exact localization before incision, even at the expense of tolerating the condition a day or so longer. This author believes that tonsillectomy is indicated only in cases with frequent relapse, and then only when the acute inflammatory stage has passed.

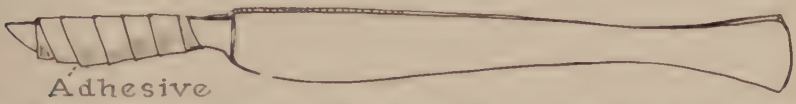

Fig. 91.—Method of wrapping scalpel with adhesive as a preliminary to incision of a peritonsillar abscess.

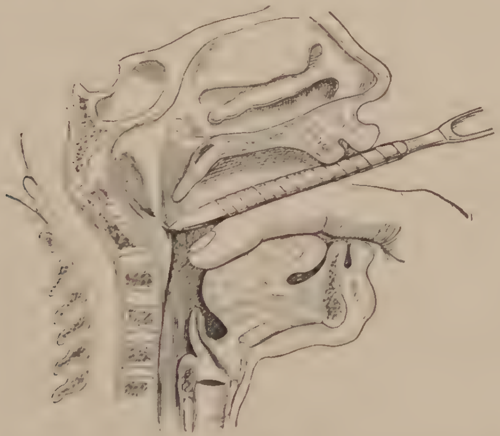

Fig. 92.—Incising retropharyngeal abscess with a cotton-covered scalpel. (From Moorhead, "Traumatic Surgery.")

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[1] Greenfield, S. D.: Arch. Otolaryngol., 7, 239, 1928.

[2] Stenger: Med. Klinik, 23, 1637, October 28, 1927.

[3] Nagel, V.: Münch. med. Wchnschr., 74, 1801, October 21, 1927.

Retropharyngeal Abscess.—Children with acute respiratory infections are occasionally subjected to the unpleasant sequel of retropharyngeal abscess. In this condition a collection of pus occurs in the submucous connective tissue of the pharynx. The usual symptoms of abscess formation are present. Dysphagia and dyspnea will be present and the child will present a sort of stertorous type of respiration due to the partial occlusion of the upper passages. The cry is peculiar and has a quacking character. Gentle palpation of the posterior wall of the pharynx will generally make the diagnosis. Care must be taken that either the palpating finger is wrapped with protecting gauze or that a mouth-gag is inserted. The treatment of this condition is entirely surgical. If untreated, it is almost invariably fatal. "If untreated, the abscess may rupture spontaneously during sleep and cause death by suffocation, or produce suffocation or fatal inanition without rupture."[1] Generous incision in the median line should be made when fluctuation is apparent, although it is unnecessary to wait for fluctuation if the other diagnostic signs be present. Guthrie[2] merely plunges into the swelling a long sinus forceps or a peritonsillar forceps and opens the blades in a vertical direction. It will be important that the child's head be placed in a dependent position to lessen the likelihood of aspiration of pus. No anesthetic should be used and the operation should be carried out as rapidly as possible.

Alveolar Abscess or Gum Boil.—In this condition there is a localized collection of pus at the alveolar border, which has resulted from infection at the root of a tooth. The abscess is readily recognized by swelling and redness of the gum border and by the marked pain. It is preceded by a throbbing toothache. According to Vaughan and Burnham[3] "the pus having formed, may discharge through the root canal of the decayed tooth or between the tooth and the gum, in which event the condition is rarely seen by the surgeon. In other cases the pus may dissect up the periosteum and appear beneath the mucous membrane at the side of the alveolar process and perforate directly through the bone to the external surface of the bone (rarely to the internal); or it may extend along the body of the bone causing an extensive osteomyelitis of the jaw."

When the process is still confined to the tooth the services of a dentist will be required. The tooth will be extracted or a hole will be drilled to permit the evacuation of the pus. When the presence of fluctuation is definitely established, incision is indicated. Very frequently fluctuation will not be present and the indication for incision will depend upon the presence of swelling and tenderness. The pain of the incision is somewhat lessened if the mucous membrane over the abscess be painted with a 4 per cent. cocaine solution. The injection of local anesthesia not only is painful, but has the danger of dissemination of infection. The incision should always be through the mucous membrane unless it is absolutely necessary to make it through the skin. The incision should be parallel to the gum-border and is best kept open by a small selvedged gauze drain for a day or two.

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[1] Saunders, T. L.: Cecil's Text-book of Medicine, W. B. Saunders Co., 1927, p. 622.

[2] Guthrie, Douglas: Brit. Med. Jour., 3441, 1174, December 18, 1926.

[3] Vaughan and Burnham: Minor Surgery, Lea & Febiger, 1922, p. 139.

Acute Glossitis.—Fortunately, acute glossitis is a rare condition, but when met with it is both serious and alarming. It has arisen after wounds of the tongue, or following sore throat or infected teeth. The tongue may swell rapidly and become so large as to embarrass respiration through the mouth. It will be stiff and tender. There is an increased flow of saliva from the enlarged and tender submaxillary and sublingual glands. The saliva cannot be swallowed and will trickle out of the mouth. The swelling may subside quickly, or in the more severe cases death may supervene in a few days.

"The treatment of acute glossitis should be energetic if the urgent symptoms detailed above are to be avoided.[1] If any cause such as a bad tooth can be found, this should be removed. Antiseptic and emollient mouth-washes and gargles should be used at once. In severe cases, however, there seems to be no treatment like a longitudinal incision into the tissues of the tongue. The incision need not be deep; it need only divide the mucous membrane which contains the tongue and so lessen the edema. Fluids can be given through a catheter down the throat."

Abscess of the tongue may arise from all manner of wounds, but particularly from those caused by the teeth. Or the abscess may be hematogenous in origin. The diagnosis is made by pain and swelling. The latter may be localized. Pain in the tongue is experienced on speaking and upon swallowing. The treatment is a free opening of the abscess cavity. The incision should not be made until the diagnosis of pus be made. It may be necessary to make several exploratory aspirations to be sure of the presence of pus. Fitzwilliams records the case reported by Butlin and Spencer, in which "while an anesthetic was being given as a preliminary to incising an abscess, this burst into the larynx and caused the death of the patient."

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[1] Fitzwilliams, Duncan C. L.: The Tongue and Its Diseases, Oxford University Press, 1927, p. 120.

Gangrene of the tongue is extremely rare and perhaps no case has been reported in modern times. Fitzwilliams reports the case of Margaret Cutting, who was shown before the Royal Society in 1742, as follows: "She lost her tongue in consequence of 'a cancer' when she was four years old. She resembled Pritchard's case in that a black speck appeared on the front of the tongue and soon ate its way to the root. She was under medical treatment all the time, and one day when the mouth was being syringed the tongue dropped out into a plate, and Margaret said, 'Don't be frightened, mamma; it will grow again.' As the tongue in those days was thought to be the essential organ of speech, the amazement of those present may be imagined. The stump took nearly three months to heal."

Acute Pyogenic Parotitis.—This affection generally occurs as a complication of a postoperative state or an acute infectious disease. There is a tender swelling at the site of the parotid gland. There may be fever, chills, and marked swelling. Frank pus may flow from the duct. In 35 cases Blair and Padgett[1] found the mortality to be 42.8 per cent. "The patient should be operated upon as soon as it appears probable that the infection will not subside spontaneously."[2] Noticeable scarring is prevented by placing the greater part of the skin incision in the angle at the junction of the cheek with the ear (Ivy).

Sialolithiasis.—Salivary calculi occur in the cystic dilation of the salivary glands. They are said usually to form about foreign bodies or mouth fungi (leptothrix buccalis) which have accidentally passed into the ducts. The stones usually consist of calcium carbonate and phosphates and rarely inspissated saliva. According to Abrams,[3] the most frequent site of salivary calculi is the submaxillary gland. The parotid is next in frequency and the lingual least of all. The symptoms are characterized by periodic pain in the area of the gland involved. In some cases there are scarcely any symptoms until the duct and gland become infected. The diagnosis is made by the history, situation of the lesion, the *x*-ray examination, and the introduction of sounds into the duct. The saliva will show plugs of mucus or even pus at the times of the exacerbations. The primary object of the surgical treatment is the relief of the obstruction to the flow of the saliva (Ivy). The stone, if present, should be removed by incision into the duct from the mucous membrane. Good results have followed slitting the constricted meatus of the duct in chronic obstructive inflammation without stone. Brooks[1] reports an interesting case of multiple salivary calculi of the sublingual gland.

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[1] Blair, V. P., and Padgett, E. C.: Arch. Surg., 7, 1, 1923.

[2] Ivy, Robert H.: Nelson's Loose-leaf Surgery, 2, 73, 1927, Thomas Nelson & Sons.

[3] Abrams, A. B.: Surgical Clinics of North America, 6, 1683, December, 1926.

Fistula.—In wounds of the cheek Stenson's duct may be severed. If this wound of the duct be within ¾ of an inch from the buccal mucous membrane and if there be a coincident wound of the buccal mucous membrane, a salivary fistula to the inside of the mouth will form and the patient will be substantially cured. If, however, this does not occur and a salivary fistula forms with external discharge, a plastic operation to reunite the severed ends will be indicated. This extremely difficult procedure belongs to the realm of major surgery.

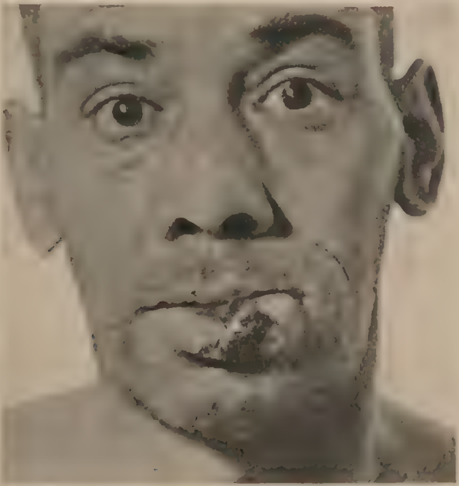

Fig. 93.—Chancre of lip. (Courtesy of Dr. Edward A. Oliver.)

It is important in all wounds of the cheek, which may or may not involve the salivary duct, *not* to suture the mucous membrane. Carefully applied horsehair or fine "dermal" sutures coapting the skin and immediately underlying tissue should be placed. Suture of the mucous membrane invites collection of pus in the wound and the possible subsequent discharge externally. This, of course, will make an uglier scar.

Infections of the Antrum.—Diseases of the air sinuses of the face will generally require the services of a rhinologist for operation, irrigation, or drainage. The recognition of their existence depends upon the presence of facial pain and tenderness and *x*-ray examination. In the case of the antrum of Highmore, transillumination of the mouth will reveal a dark area in a pathological antrum. The application of warm fomentations is a useful first-aid measure.

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[1] Brooks, H. L.: Abstract, Jour. Amer. Med. Assoc., 90, 293, January 28, 1928.

Necrosis of the Jaw and Sinuses from the Teeth.—Carious teeth will often cause a draining sinus at the alveolar border and may even involve the tooth sockets themselves, causing an osteomyelitis. Osteomyelitis of the jaw may also be caused by fractures, which, of course, are accompanied by wounds of the overlying mucous membrane. Many of these cases will clear up following extraction of the affected tooth and the use of mild alkaline antiseptic mouth-washes and hot fomentations. Pus pockets should be evacuated. When necrosis occurs, it is better to wait for the natural separation of the sequestrum than to attempt to remove the diseased bone.

Chancre.—The primary lesion of syphilis is occasionally found on the face, more commonly on the lips. The diagnosis is made by the hard indurated ulcer (Fig. 93) and by the positive dark field examination. The treatment, of course, is limited to general antiluetic therapy.

CHAPTER X

TUMORS AND DEFORMITIES OF THE HEAD

I. BENIGN TUMORS OF THE HEAD

Comedo.—A comedo is a "blackhead" or a plug of dried sebum in an excretory duct of the skin and, according to Dorland, occasionally contains the Demodex folliculorum. The removal of comedones is best effected by pressure with a small metal instrument, so shaped that there is a small ring at the end. The pressure with the ring causes a uniform force about the margin of the comedo and expresses it. The expressor and the skin surface should first be sterilized.

Sebaceous cysts (**atheroma, wen**) are retention cysts which apparently have been caused by the obstruction of the duct of the sebaceous gland and the consequent accumulation of sebum and desquamated epithelium. They may be found in practically any portion of the body. Caylor[1] made a special study of 236 cases in which sebaceous cysts had been excised at The Mayo Clinic and found the regional distribution to be as follows:

Site.	Per cent.
Abdomen	2.16
Arm	0.87
Axilla	3.03
Back	4.32
Breast	5.62
Buttock	3.46
Cheek	9.51
Chest	4.32
Ear	0.43
Face (including forehead, cheeks, jaw, lips, and parotid region)	16.01
Fingers	1.29
Forehead	3.03
Hand (palm)	2.59
Jaw	1.29
Leg	0.43
Lip (lower)	0.43
Lumbar region	0.87
Mastoid region	1.29
Neck (including back and front)	14.71
Parotid region	1.73
Scalp	28.13

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[1] Caylor, H. D.: Ann. Surg., 82, 164, July, 1925.

Site.	Per cent.
Scrotum	0.87
Shoulder	4.76
Thorax (including front and back of chest and breasts)	14.28
Temporal	2.16
Thigh	2.59

It will be seen from the above table that the scalp is the most frequent site of the cysts, with the face and neck next in order of frequency (Fig. 94). As many as 22 cysts have been removed from the scalp at a single sitting.[1] The cysts vary in size from a pea to 7 to 8 cm. in diameter. The lining sac is composed of flat epithelium and a cure is not effected until this sac is completely removed. Not uncommonly the cysts become infected, in which event they swell, become tender and the contents are evacuated either spontaneously or through incision. The process then subsides but recurs frequently until the cyst has been removed. The cysts are more liable to occur in the later years of life.

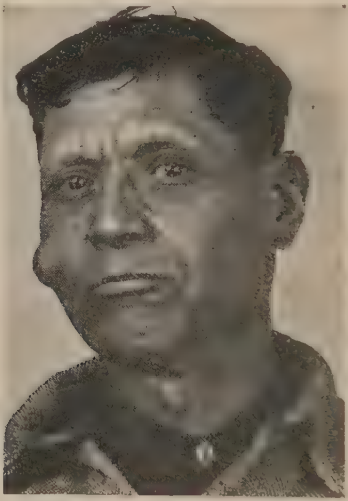

Fig. 94.—Sebaceous cyst of the face. (Surgical Dispensary, Northwestern University Medical School.)

Sebaceous cysts may be distinguished from lipomata by the absence of lobulation ("signe de peu d'orange," see p. 208) and by the fact that sebaceous material may be squeezed out if there be an opening. In Dercum's disease the alcoholic history is suspicious. Dermoid cysts are congenital, are generally first noticed in the young, their lining is composed of true epithelium; they are usually deep seated and attached to the pericranium; they are especially common about the orbits, anterior fontanel, and occipital protuberance. Their contents are similar to that of wens. Fibroma molluscum is a solid pedunculated tumor, and is nearly always multiple.

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[1] Poncet, quoted by Cushing.

Treatment.—"All sebaceous cysts should be removed, for they may become the site of a malignant tumor" (Caylor). Some 3.44 per cent. of the cysts in Caylor's series became malignant. If there be ulceration or recurrence of the lesion, excision is demanded. When there is infection and abscess formation, the treatment will be limited to incision or poulticing. The removal of the sac will have to be deferred until the infection has subsided.

The removal of a sebaceous cyst of the scalp is a matter which requires careful surgical technic. The larger the cyst, the more readily and easily it can be removed. The hair should be clipped and the skin shaved for at least 1 inch around the margins of the cyst. The skin area should then be carefully painted with full strength tincture of iodine or mercurochrome-acetone solution. The hair will be compressed and held in place by a snug bandage or towel and the field of operation surrounded by sterile gauze or towel (Fig. 95). The lines of incision over the convexity of the wen will then be infiltrated with $\frac{1}{2}$ or 1 per cent. novocaine. This line of infiltration should extend $\frac{1}{4}$ to $\frac{1}{2}$ inch beyond the wen, above and below. The deeper portions of skin

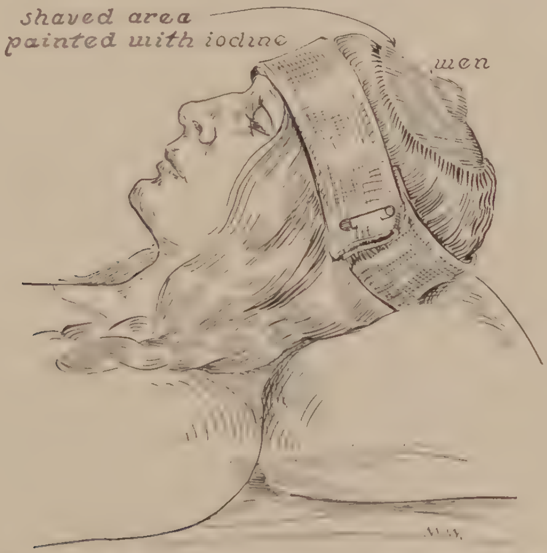

Fig. 95.—Preparation of field of operation for excision of wen of the scalp. The skin is shaved about the wen and is painted with iodine. The hair is held out of the wound by a pinned towel.

underlying the wen should then be infiltrated with hypodermic injections (Fig. 96). The incision is made over the convexity over the wen with the excision of an elliptical portion of the skin lying on the convexity itself (Fig. 97). This is then to include the possible sinus or plugged sebaceous duct and also to remove the redundant skin to better approximate the skin edges after the removal of the cyst. After the skin has carefully been cut through with a sharp scalpel, the edges of the wound are divulsed by spreading the points of the scissors or fine

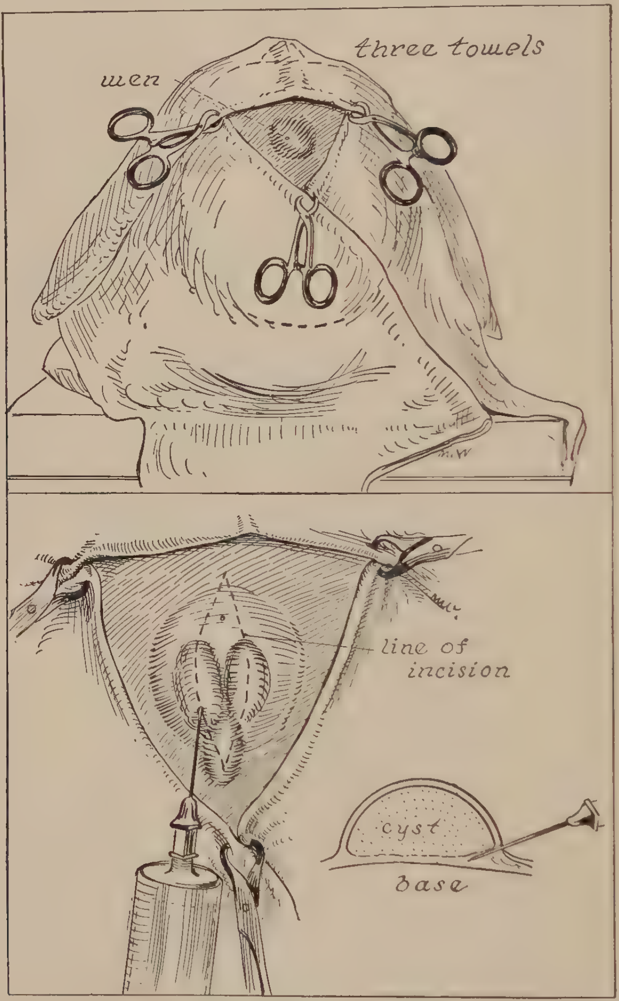

Fig. 96.—Draping of the field of operation preparatory to excision of wen of the scalp. Infiltration of elliptical incision with local anesthesia. Infiltration of the scalp at the base of the wen.

hemostat and, if possible, the sac will be exposed and identified. A cleavage plane will be found between the sac wall and the underlying tissues and by further divulsion by means of the scissors, the sac will be separated from its bed. It is desirable to remove this cyst without rupturing its wall and spilling the caseous contents, which not infrequently contain micro-organisms. Unfortunately, the cyst will sometimes be cut into in efforts to remove it and the contents will be spilled in the wound. If this occurs the caseous material had best be wiped away as well as possible and the cyst wall, which is often very tough, will be grasped by a mosquito forceps. By traction upon this forceps

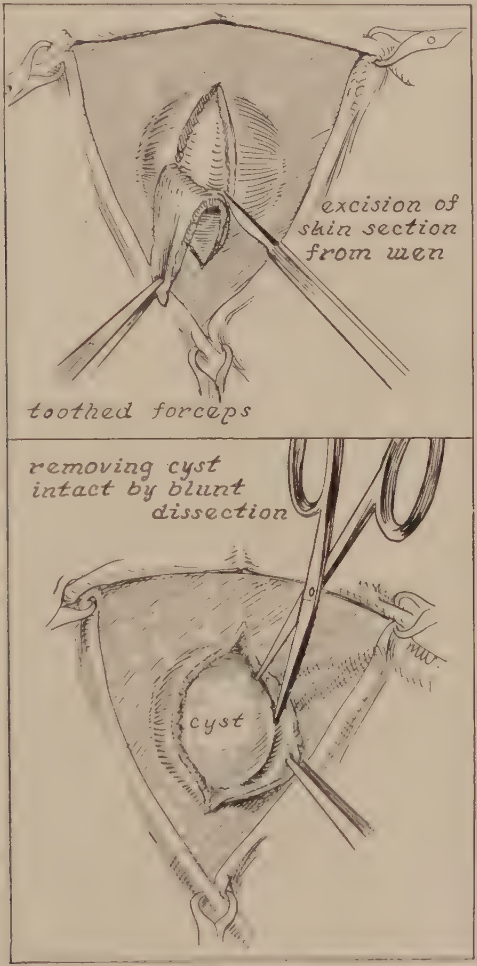
excision of
skin section
from wen
toothed forceps
removing cyst
intact by blunt
dissection
cyst

Fig. 97.—Excision of elliptical piece of skin. Below: Freeing wen from its attachment by blunt dissection. The scissors points are carefully divulsed.

and further dissection with the scissors, the sac will be removed (Fig. 98). If by any chance a small part of sac wall be left behind, its epithelial lining should be cauterized with carbolic acid or other cauterizing agent so as to destroy it. If the sac contents have been spilled in the removal, it will be well to swab out the wound with mercurochrome or other antiseptic before closure. The skin is then coapted with two or three non-absorbable sutures and a firm dressing applied. If the wound has been cauterized or if there is any reason to believe that infection be present, it will be wise to put in a small drain for twenty-four hours. On the scalp this dressing is best held in place by a circular bandage about the skull. Where a strenuous objection is raised to a head bandage, the next best thing is a small circular gauze dressing which may be

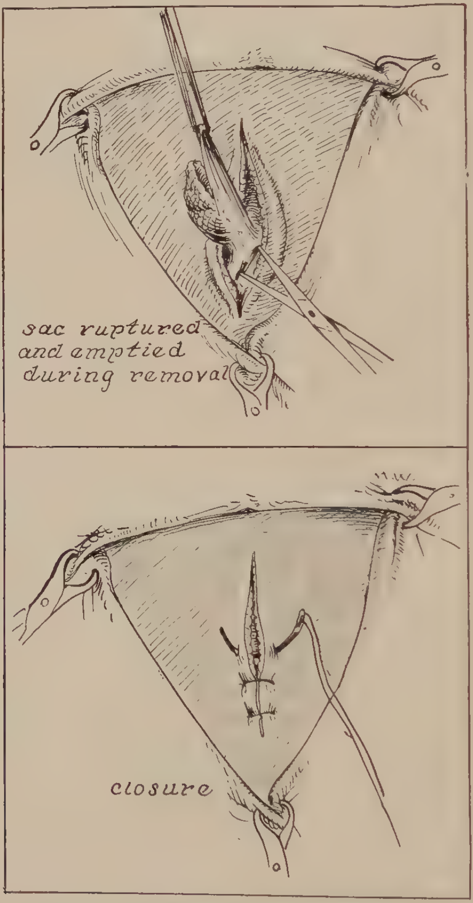

Fig. 98.—Procedure in case the wen is inadvertently ruptured in the process of removal. Below: Closure of skin.

fastened to the shaved skin by liquid adhesive, collodion or, less desirably, by adhesive plaster. It is best to dress the wound twenty-four hours after the operation, taking care to remove the gauze in the same direction as the wound. The stitches will be removed on the fourth to sixth day unless redness, discharge, and pain indicate inflammation, when they should be removed earlier. (See Fig. 452 as to the correct method of removal of stitches.)

Epidermoid cysts are epithelial-lined cavities which are caused by the traumatic implantation of bits of epithelium in the subcutaneous tissues or by cell rests. There they proliferate and form a cyst wall (Fig. 99). The cyst may only become apparent at a considerable interval after the accident; in 1 case some ten or fifteen years.[1] They are more liable to occur on the fingers or toes which are most exposed to severe trauma. The removal is effected in the same manner as that of the sebaceous cyst described above.

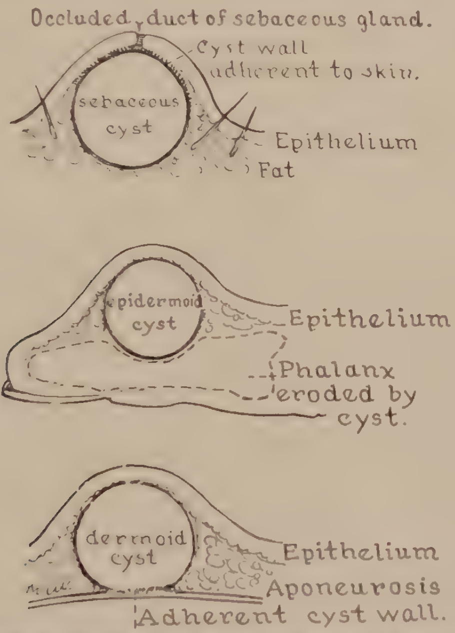
Occluded duct of sebaceous gland.
Cyst wall adherent to skin.
sebaceous cyst
Epithelium
Fat
epidermoid cyst
Epithelium
Phalanx eroded by cyst.
dermoid cyst
Epithelium
Aponeurosis
Adherent cyst wall.

Fig. 99.—Diagram indicating the chief differences between sebaceous cyst, epidermoid cyst, and dermoid cyst. The sebaceous cyst is generally attached to the skin at the site of the occluded duct of the sebaceous gland. The epidermoid cyst does not have this attachment, is lined by epithelium, does not contain hair, and may erode adjacent bone. The dermoid cyst is often adherent to the aponeurosis, and may contain hair or other epithelial structures.

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[1] Christopher, F.: Epidermoid Cyst with Pressure Atrophy of the Adjacent Bone. Report of a Case, Minnesota Med., September, 1925.

Dermoid Cyst.—The discussion of dermoid cyst is so admirably handled by Foote[1] that it does not seem to the writer that it can be improved upon, and it is accordingly herewith reproduced.

"A dermoid cyst is of congenital origin, and occurs in one of the lines of embryonic closure of the skin. It may be apparent at birth, or it may not be noticed until some years afterward when its increase in size first attracts the attention of the patient or some friend. Some dermoid cysts are made up of a single layer of epithelium, with sebaceous contents, in which a few hairs are sometimes found. If the attachment of the dermoid cyst to the deeper structures is slight, its removal is almost as simple as the removal of a sebaceous cyst. Some dermoid cysts have extensive deep attachments so that their removal is difficult and may be followed by a permanent scar. It is of the greatest importance, therefore, that a correct diagnosis of dermoid cyst be made before its removal is attempted.

"*Differential Diagnosis.*—A mistake in diagnosis lies chiefly between a dermoid cyst and a sebaceous cyst; hence the importance of considering in detail the points of difference. The common situations in which sebaceous cysts are found have already been spoken of. They include nearly all the situations in which a dermoid cyst of the head is likely to be found. Dermoids occur chiefly about the inner or outer angle of the orbit, or in front of or behind the ear. A sebaceous cyst is rare in childhood; dermoids occur in infancy, childhood, and adult life. A sebaceous cyst is always attached to the skin at one point; a dermoid is usually covered by normal, freely movable skin. A sebaceous cyst is invariably movable with the skin on the deeper structures; the base of a dermoid is invariably attached to the deep fascia or to the periosteum, or, in case of the ear, to the perichondrium. This point is not always easy to make out, since the more superficial portion of the dermoid cyst may swing back and forth upon its own fixed base, but to slide the cyst as a whole backward and forward is impossible. Both cysts plainly fluctuate when they have reached a sufficient size.

"During the operation it will be noticed that the sac of a dermoid cyst is usually thicker than that of a sebaceous cyst, and that is especially true of its deeper portion. Furthermore, the attachment of its base will become more and more manifest as an attempt is made to dissect it free. It can never be freed by blunt dissection, since it is anatomically connected with the deeper tissues. If it contains hairs, the diagnosis is certain.

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[1] Foote, E. M.: A Text-book of Minor Surgery, 3d ed., D. Appleton & Co., 1912, p. 72.

"A dermoid cyst which contains little sebaceous matter, and does not fluctuate, may be mistaken for a lipoma or a small, deep-seated angioma. The size of the latter can always be reduced by compression, but it is promptly restored when the relief of pressure allows the blood-vessels to refill.

"*Treatment.*—The incision for the removal of a dermoid cyst near the orbit should be made through the eyebrow, the hair first having been shaved off, or it should follow the direction of a wrinkle in the forehead or about the angle of the eye, so that the scar shall be insignificant. The separation of the overlying skin from the cyst is easily accomplished, while the dissection of the base of the cyst from the bone may be difficult. For this reason, unless the patient is of a very quiet and courageous disposition, it is better to give a general anesthetic as it is difficult to obtain complete anesthesia of the part of the cyst adherent to the periosteum by means of cocaine or eucaine. After most of the sac has been freed it should be split open and emptied, so that the operator may know exactly how far its cavity extends. Sometimes the cyst can be dissected free from the periosteum without injury to the latter. More often a part of its base is really formed by the periosteum, so that complete removal of the cyst will necessitate the removal of a little periosteum. This is not a serious matter as necrosis will not follow unless the wound suppurates. The operative wound should be sutured and a firm dressing applied to obliterate the cavity due to the removal of the cyst.

"When the dermoid cyst is situated in front of or behind the ear, it may sometimes be so closely associated with the cartilage of the auditory canal that its inner portion reaches to the base of the skull. Under these circumstances as much of the cyst as is accessible should be removed and the remainder should be cauterized with carbolic acid."

Mucous Cysts.—There are small cysts, rarely larger than a pea, on the mucous membrane of the mouth or lips. They contain a glairy mucous fluid; on the thin overlying wall is a thin layer of mucous membrane. They occur more commonly in children. They can very readily be cured with or without surface anesthesia by simply excising the overlying wall of the cyst with a small, sharp scissors and tissue forceps.

These cysts will not recur if all of the overlying wall be removed. Snipping the wall and swabbing the cyst with iodine is recommended by Vaughan and Burnham. Carbolic acid has been recommended for cauterization.

Ranula.—Fitzwilliams[1] has made an extensive study of the subject of ranula. He says, "Ranula is a loose term inherited from bygone days and used widely over the world, but it is a term in medicine which cannot be defined and has no scientific meaning. It has been applied to all cystic swellings of the floor of the mouth whatever their form or origin. Dermoid swellings, swellings in connection with calculi of the salivary glands, acute swellings, traumatic swellings, parasitic swellings, swellings below the jaw, and even below the hyoid bone in connection with the thyroid gland, have all been included under the term ranula. . . . There is no one and only cause of these swellings." Ranulæ have originated in the mucous glands, the sublingual gland, Blandin's gland, and even in the submaxillary gland. Fitzwilliams defines as "traumatic ranula" those cases where a swelling results from the blocking of Wharton's duct as the result of a traumatism, or by a membrane. Some of the ranulæ may be very large and show a propensity to burrow, the extension going through the mylohyoid muscle to below the chin and up into the cheek and neck (Figs. 100, 101).

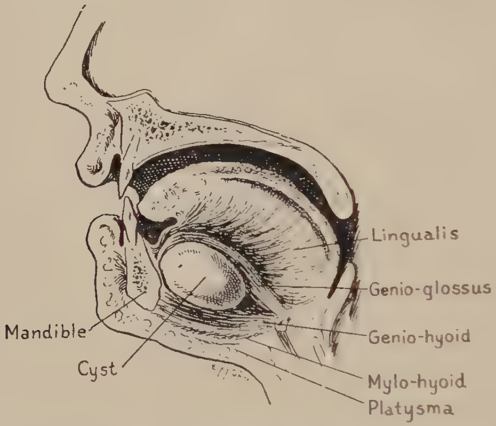

Fig. 100.—Sublingual type of cyst occurring above the geniohyoid muscle. (Eliason, E. L., Therapeutic Gazette, April 15, 1926.)

Treatment.—The best treatment for ranula is excision where this is feasible. It should be dissected out like any other cyst. In some cases where this is not feasible a large portion of the anterior wall should be removed and the edges of the mucous membrane of the cyst will unite with the edges of the mucous membrane of the mouth. In extensive cysts healing is hastened by suppuration or inflammation, or swabbing the interior with pure carbolic or zinc chloride, 40 grains to the ounce (Fitzwilliams).

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[1] Fitzwilliams, D. C. L.: The Tongue and Its Diseases, Oxford University Press, 1927, p. 240.

Keloid.—A keloid is a fibroma or connective-tissue growth in the corium or true skin. It is a hard fibrous and vascular growth generally arising in scar tissue. It is said to attack the mucous membranes but rarely. A special predisposition to keloid formation is present in certain individuals and it is thought possible that this is hereditary.

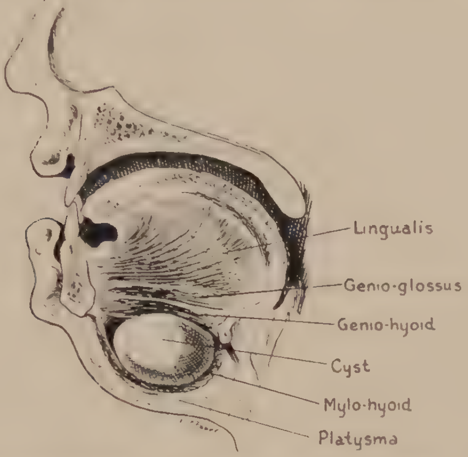

Fig. 101.—Submental type of cyst. Note the geniohyoid muscle above and the mylohyoid muscle below. (Eliason, E. L., Therapeutic Gazette, April 15, 1926.)

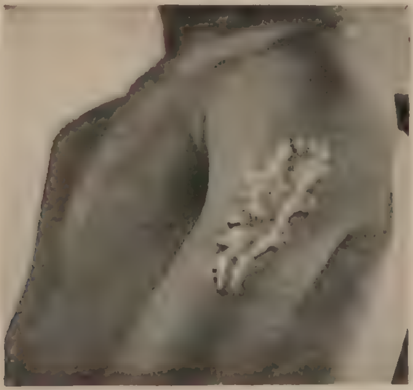

Fig. 102.—Keloid. (Surgical Dispensary, Northwestern University Medical School. Courtesy of Dr. John A. Wolfer.)

The colored race and those afflicted with tuberculosis of the lymph-nodes are more prone to keloid (Fig. 102). While it may occur after any injury it is more likely to occur following burns. The keloid may develop over many years and may subside spontaneously. The etiology of keloid is not definitely known. DaCosta,[1] who is very much interested in this subject, is somewhat impressed as to there being some association between tuberculosis and keloid. Repeated examinations have failed to demonstrate the presence of bacteria in the scars, and DaCosta suggests that the toxins of the tubercle bacillus may be the irritant cause. Brenizer[2] does not believe that tuberculosis is in any direct way the cause of keloid. Crocker[3] believes the microbic origin to be very plausible because of the fact that lesions following suppuration are particularly likely to be followed by keloid and that when the process is once started in a scar, old ones, long quiescent, become keloidal. The pathology is given by Fordyce[4] as follows: "The growth is situated in the central and lower portions of the cutis. It begins in the walls of the larger vessels and, when fully developed, is composed of dense collagenous bundles, which are arranged for the most part parallel with the long axis of the tumor, ultimately compressing all the structures in their vicinity. According to Warren, the vessels are affected some distance from the keloidal growth." Unfortunately the growth is but little influenced by treatment. Fordyce says that sarcomata have been noticed after keloidal growths. Operation is rarely successful, and recurrence seems to be the rule. The injection of 10 to 15 minims of 10 per cent. solution of thiosinamin into the gluteal muscles every third day has been advocated but has not proved of value. *x*-Ray is to be tried. According to Codman,[5] a few exposures will show improvement if any is to be expected. DaCosta has seen 2 cases cured by *x*-ray. Grier[6] has obtained uniformly satisfactory results in the treatment of keloids with unfiltered Roentgen rays. This writer says that the amount of radiation applied at each treatment should not exceed 90 per cent. of an erythema dose. Six or eight weeks should elapse between treatments. When keloids are subjected to a vigorous treatment with radium, remarkable results have been obtained but it is often necessary to produce a definite burn of the skin if the scar tissue is very thick.[7] According to Fordyce, "mincing up the tissue by linear incisions to divide the vessels as thoroughly as possible has been followed by improvement and even disappearance." Northrop[1] has removed a number of keloids with the high-frequency d'Arsonval current with no recurrence in any case. The electrothermic coagulation was carried out with an ordinary large-sized sewing needle. MacKee and Eller[2] report the rapid cure of a large keloid by the combined use of the endotherm knife and small doses of x-rays.

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[1] DaCosta, J. C.: Modern Surgery, 9th ed., 1925, W. B. Saunders Co., p. 301.

[2] Brenizer: Ann. Surg., 61, 1925, quoted by DaCosta.

[3] Crocker: Diseases of the Skin, quoted by Fordyce.

[4] Fordyce, John A.: Keen's Surgery, 2, 631, 1914, W. B. Saunders Co.

[5] Codman, E. A.: Keen's Surgery, 5, 1175, 1924, W. B. Saunders Co.

[6] Grier, G. W.: Amer. Jour. Roentgenol. and Radium Therap., 16, 26, July, 1926.

[7] Duane, William, and Greenough, R. B.: Keen's Surgery, 8, 759, 1921, W. B. Saunders Co.

Parotid Cysts.—Retention cysts may form anywhere in the parotid gland. Such cysts should be removed as completely as possible. Because of the tendency to accumulation of the parotid secretion, these wounds should be drained until the secretion gradually ceases, although this may take a number of weeks. Small parotid cysts may form in the healing wounds which have involved the parotid gland. When the epithelium closes over, and the cyst begins to form, the latter should be punctured and the secretion allowed to escape. This process may have to be repeated, and suppuration will accelerate the closure.

Warts (Cutaneous Warts, Verruca Vulgaris).—The common wart of the skin is a benign epithelial hypertrophy. According to Ewing,[3] "it occurs on exposed regions of the skin, especially on fingers, hands, and face. The duration is very variable, some disappearing after a few weeks, others persisting for years. A tendency to recurrence is often noted. . . . In young subjects very numerous small flat warts may appear on the backs of both hands (verruca plana juvenalis). . . . The structure exhibits an overgrowth of the entire malpighian layer with folds and projections into which extend thin strands of stroma. In some cases there is a considerable increase of blood-vessels approaching the type of the papillary nevus, and for these a congenital origin is probable. . . . There are numerous clinical observations suggesting the contagiousness of warts, but on analysis they can be dismissed as examples of the transfer of peculiar chemical irritants, or exposure to the same irritant, or the actual transfer of proliferating epithelial cells. Payne saw three warts develop under the nail of his thumb which he had used to separate a wart from its base. In many instances warts have developed upon the skin of opposed surfaces. Lanz implanted a series of warts on the back of his gardener's hand by inserting the comminuted fragments under the epidermis. From 74 inoculations from warts in 4 adults, Judassohn secured in two to six months, 33 warts."

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[1] Northrop, Herbert L.: Surgical Clinics of North America, December, 1925, p. 1671, W. B. Saunders Co.

[2] MacKee, G. M., and Eller, J. J.: Physical Therapeutics, 44, 391, July, 1926.

[3] Ewing, James: Neoplastic Diseases, 3rd ed., W. B. Saunders Co., 1928, p. 487.

Excision of warts occasionally is done but it is often unsatisfactory because of the incidence of recurrence, the trouble incident to infiltration, excision, and placement of stitches, and to the resultant scar. Repeated applications of glacial acetic acid or nitric acid will sometimes cure a wart but it requires extreme care that the surrounding skin be not injured. The best methods of removal of warts are the application of radium, of *x*-ray, or of carbon dioxide snow. Verruca treated by radium with proper protection of the surrounding skin will often disappear in two or three weeks after a single application.

DaCosta[1] lists other methods of treatment. Daily applications of lactic or chromic acid; the employment of solid carbon dioxide held in contact with the wart for thirty or forty seconds; the constant keeping of the wart moist with castor oil; painting once a day for five days with pure carbolic and covering with lint kept wet with boric acid; the daily painting of the wart with a solution composed of hydrargyrum chloridum corrosivum, dram $\frac{1}{2}$, collodion, drams 15; destruction by electrothermic methods. Cauterization by the heated carbon of a lead pencil has been effectual.

Moles (Nevus).—The pigmented mole or nevus occurs chiefly on the face, neck, or back. It may even appear on the sole of the foot, and in this and other exposed positions is more liable to malignant change.[2] The *nevus spilus* is a minute pigmented spot; the *nevus verrucosis* is a soft, flat elevation which often grows to a warty excrescence; *nevus pilosus* includes hair; and the *nevus papillaris* is a papillary tumor. The source of these tumors is the chromophore, a specific mesoblastic cell, and when the moles undergo malignant change to melanomata, it is often difficult to know whether or not to identify the tumor with sarcoma or with carcinoma. Ewing says, "The natural history of the vast majority of pigmented nevi includes a long period of slow growth, a stage of inertia, followed by process of regression. A congenital disturbance of the structure of the derma must be assumed for all cases, and some moles are visible at birth. Many more appear in early life, and, according to Unna, these always show evidences of progressive growth. Having reached the limit of growth, which is commonly restricted to small innocuous tumors, they tend to undergo fibrosis and atrophy. Some become hard, flat, and circumscribed (fibromatous degeneration), others become pedunculated, fissured, or extruded (molluscoid degeneration). Repeated traumata often cause a limited overgrowth. Malignant melanoma develops in a small proportion of cases, usually after trauma or incomplete extirpation. . . . A slight enlargement or increase of pigmentation of the tumor may be the first sign of malignant change which may be checked by wide extirpation. Following operation or without, there may be rapid local growth or extension, but some cases remain localized with repeated extensions for many years." Most moles are small (0.5 cm.) but they may be much larger. Bland-Sutton[1] says that as many as fifty may be present upon an individual. The usual color is brown and they may contain an abundant crop of hairs. Moles are removed because they are unsightly and also because of their occasional transformation into malignant growths. Those moles which are subjected to irritation or which are enlarging should be removed at once. Dr. Bloodgood, of Johns Hopkins, was particularly impressed with the potential peril of moles which were subjected to irritation of men's stiff collars.

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[1] DaCosta, J. C.: Modern Surgery, 9th ed., W. B. Saunders Co., p. 325.

[2] Ewing, James: Neoplastic Diseases, 3rd ed., W. B. Saunders Co., 1928, p. 921.

Excision is probably the safest method of removing moles. The mole and at least $\frac{1}{8}$ inch of the surrounding skin should be removed in one block, without cutting into the mole or traumatizing it in any way. If local anesthesia be used, the injection should be well away from the lesion. DaCosta[2] says that a mole, "if not too large, may be removed by the application of solid carbonic acid for thirty seconds."

Angioma.—An angioma is a tumor made up of newly formed vessels; if the blood-vessels predominate it is called a hemangioma, if the lymph vessels predominate it is a lymphangioma. The simple angioma is sometimes spoken as of a *vascular nevus* or a *telangiectasis* and occurs in several forms. The *nevus vinosus* or *port-wine stain* is a new growth of the superficial capillaries, the overlying skin being so thin that the color

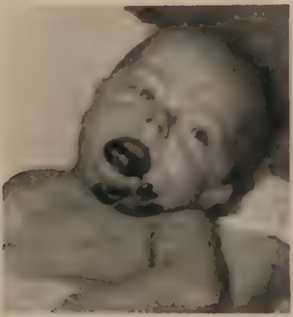

Fig. 103.—Hemangioma of the face. (Children's Memorial Hospital, Chicago. Courtesy of Dr. Edward A. Oliver.)

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[1] Bland-Sutton, Sir John: Keen's Surgery, W. B. Saunders Co., 1, 756.

[2] DaCosta, J. C.: Modern Surgery, 9th ed., W. B. Saunders Co., p. 303.

of the blood is imparted to it. Pressure, particularly with a glass plate, will express the blood and cause the color to disappear. This type is usually congenital and occurs oftenest on the face. In the *plexiform angioma* the small vein and arterioles are involved in addition to the capillaries. The neoplasm occurs in the derma, subcutaneous tissues, and fat, and forms a definite swelling or tumor. This tumor likewise pales upon pressure. The lesion generally occurs in early infancy and tends to enlarge rapidly. The *cavernous angiomata* are those

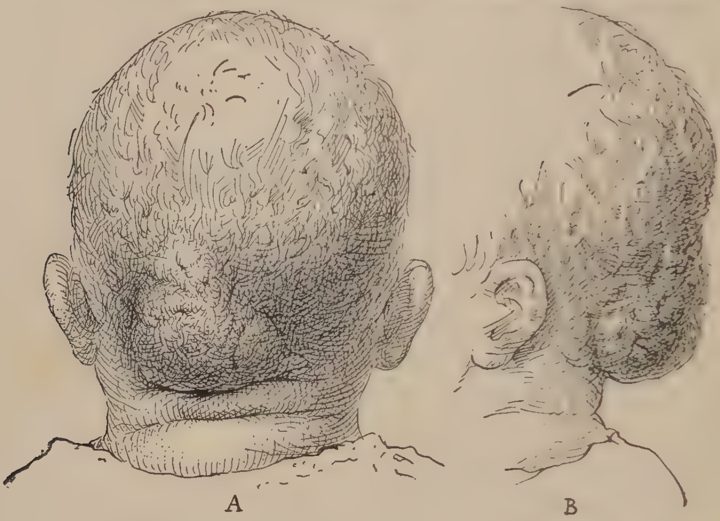

Fig. 104.—Hemangio-endothelioma of the scalp. *A*. Anteroposterior view; *B*. Lateral view. (Christopher, Frederick, Surgical Clinics of North America, August, 1925.)

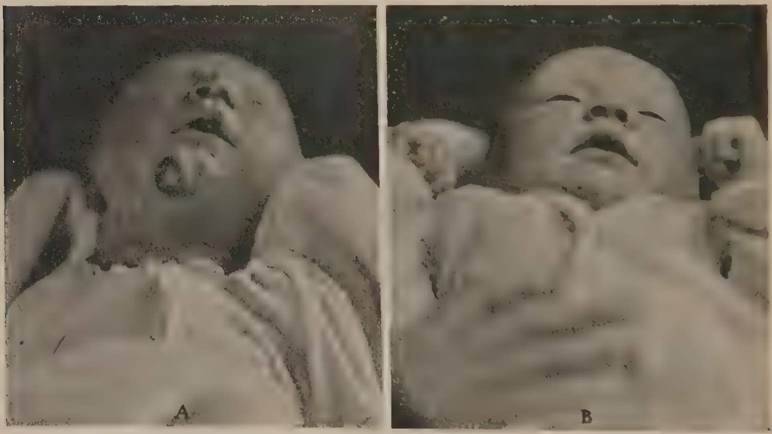

Fig. 105.—Fibro-endothelioma of the chin. *A*, Before excision; *B*, after excision. (Christopher, Frederick, Surgical Clinics of North America, August, 1925.)

angiomata in which the vascular channels are widely dilated and the connective-tissue septa are thin (Figs. 103–105). "In the skin cavernous angiomata produce circumscribed or diffuse, flat or elevated lesions, involving the derma and subcutaneous tissue. If superficial, they are dark red in color. If covered by corrugated and thickened epidermis, they become warty. Changes in the circulation affect the size and color of the tumors" (Ewing). These lesions may develop from simple angiomata. The *malignant metastasizing cavernous angiomata* are sharply to be differentiated from the benign and their consideration is foreign to the field of minor surgery.

Numerous treatments have been employed in cases of angiomata. For the capillary nevus one or more applications of solid carbon dioxide or electric desiccation are of value. Injection of boiling water or of quinine and urea hydrochloride has been advocated. When the lesion is small, excision will secure good results. For the larger angiomata Clark[1] has secured excellent results by electrodesiccation. Thirty to forty seconds' pressure with solid carbon dioxide will bring about a cure in one or more applications in some cases. Radium and *x*-ray are also of great value in the treatment of this condition. Strauss[2] says that the treatment of cavernous hemangioma is simple with radium, and that it can be applied to an infant with better results than in older patients. Where excision is determined upon, special care must be observed in the control of hemorrhage.

Tavares[3] reports the removal of a pedunculated cavernous hemangioma of the upper lip by excision. This tumor was 8 cm. long and 7 cm. broad. The author[4] excised a hemangio-endothelioma of the scalp of a ten weeks' babe.

Lipoma is a tumor composed of fat tissues. Lipomata vary greatly in size, some of them weighing many pounds. In the case of internal lipomata their size may become so great as to cause death by pressure symptoms (Ewing). These tumors are painless and benign. Their occurrence about the head is infrequent. The commonest sites are the back, neck, shoulders, axilla, and abdominal wall. The most common type is encapsulated. The diagnosis of lipoma may occasionally offer difficulty because of its resemblance to a sebaceous cyst. An important sign found in lipomata is the orange-peel sign ("signe de peau d'orange"). This is elicited by compressing the tumor between the thumb and forefinger, when it will be seen that the skin overlying the fatty mass is irregularly dimpled by the downward traction of the subcutaneous vertical trabeculæ (Fig. 106). The sense of fluctuation found in a lipoma may be almost identical with that of a fluid cyst. The latter, however, fails to show the orange-peel sign.

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[1] Clark, W. L.: Keen's Surgery, 8, 813, 1922, W. B. Saunders Co.

[2] Strauss, A.: Amer. Jour. Roentgenol. and Rad. Th., 19, 265, 1928.

[3] Tavares, A.: Ann. d'anat. path., 1926, 3, 147.

[4] Christopher, F.: Surgical Clinics of North America, W. B. Saunders Co., August, 1925, p. 1087.

The *treatment* of lipomata is excision, which usually may be carried out under local anesthesia. They need only be removed for cosmetic reasons or because of uncomfortable pressure which they may produce. The encapsulated variety is readily shelled out by blunt dissection after the skin has been incised. The diffuse type will require sharp dissection. Vaughan and Burnham[1] advise that "after the tumor has been removed, plain gut sutures should be so placed that when tied they will tend to draw together the walls and obliterate the cavity. Several such sutures may be required. If this is done, postoperative subcutaneous hematoma is less liable to occur."

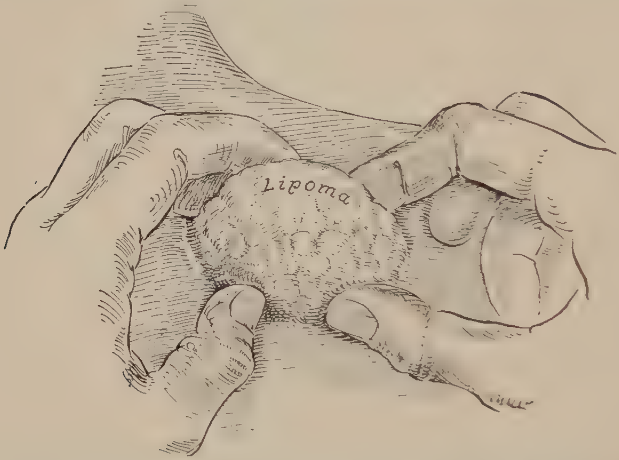

Fig. 106.—Orange-peel sign ("signe de peau d'orange") in the diagnosis of lipoma. Lateral compression of the tumor lifts the surface skin upward, the relatively fixed vertical trabeculæ causing a multiple dimpling of the skin.

Osteoma (Exostosis).—These benign overgrowths of bone may occur upon the skull or upon the jaw. They are generally removed because of their unsightliness or because they are subject to traumatism. The tissues above the osteoma are readily incised under local anesthesia, but owing to the difficulty of rendering bone insensible by means of local anesthesia, it is advisable to use gas during the removal of the osteoma. A chisel or rongeur will readily remove the neoplasm.

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[1] Vaughan, J. C., and Burnham, A. C.: Minor Surgery, Lea & Febiger, 1922, p. 207.

Fibroma.—Fibroma may occur upon the jaw. They generally begin to develop between the ages of seven and fourteen years. These tumors are firm, smooth, and circumscribed. They are attached to the bone but not to the overlying soft tissue and are not tender. Some of these fibromata will undergo ossification. Montgomery[1] reported 3 cases of osteofibromata of the jaw and collected 17 cases from the literature. Surgical removal is the only treatment indicated and recurrence will not take place after thorough operative removal.

Xanthomata are small yellow growths of the skin, particularly (over 90 per cent.) on the eyelids. "The structure of xanthoma is characterized chiefly by the great abundance of lipoid globules in large swollen polyhedral and smaller spindle-shaped cells."[2] These nodules are often extremely disfiguring and may readily be removed by excision under local anesthesia, and the subsequent coaptation of the skin with tiny horsehair sutures. The incisions should parallel or correspond to the wrinkles of the eyelid.

Granuloma of the gum border may occur from the chronic irritation of a discharging sinus incident to a carious tooth or osteomyelitis of the jaw. Its treatment calls for excision by scissors or cauterization by silver nitrate stick.

Epulis.—The term "epulis" applies to such connective-tissue tumors which have a circumscribed growth from the alveolar ridge at the gingival margins of the teeth. They generally have a small attachment and spread over the gum surface. According to Ivy,[3] "in their early stages, these growths may be essentially chronically inflammatory in nature, due to irritation of food or tartar beneath the gum margin, ill-fitting crowns and fillings, or carious cavities. Eventually they pass over into the tumor group, and are all essentially of the connective-tissue type. When fully developed, they may be classified into three principal varieties: *(a)* Fibroma; *(b)* fibro-angioma; *(c)* giant-cell tumor." These three types have a microscopical and clinical differentiation. Ivy has given us the following directions for the removal of epulis: "Under local anesthesia, an incision in the healthy gum, just outside the limits of the growth, is made down to the bone. Through this incision the tumor is then freed as much as possible from its soft tissue attachments. The tooth most likely to be involved is then extracted, and the tumor may come away, attached to the periodontal membrane near the neck of the tooth. If not, the tooth on the other side of the tumor must be removed. The bony margins of the tooth sockets are trimmed smooth with rongeur forceps. In some cases it is possible to fashion a flap of healthy gum and suture it over the exposed bone surface. If not, the raw bleeding surface can be covered with a small piece of iodoform gauze." Epulis may be treated successfully with radium.[1, 2, 3]

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[1] Montgomery, A. H.: Arch. Surg., 15, 30, 1927.

[2] Ewing, James: Neoplastic Diseases, 3rd ed., W. B. Saunders Co., 1928, p. 175.

[3] Ivy, R. H.: Nelson Loose-leaf Surgery, 2, 649, 1927, Thomas Nelson & Sons.

Dentigerous Cyst (**Odontocele, Coronodental Cysts**).—"A dentigerous cyst, or odontocele, is a benign hollow tumor due to proliferation and degeneration of cells of the enamel organ before eruption of a tooth, which lies partially or completely within the cyst cavity."[4] A fully or partly developed tooth projects into the cavity. Ewing[5] says that the tooth is usually misplaced, lying horizontally, a position which prevents its eruption. Hopewell-Smith[6] says that in examining the unerupted tooth lying in the cyst sac, he found that it possessed no enamel cuticle or Nasmyth's membrane. "From this he argued that the outer layer of cells of the enamel organ, instead of adhering to the enamel of the tooth as Nasmyth's membrane, has separated from it and forms the epithelial lining of the cyst capsule. He accounts for the mucous fluid in the cyst cavity by degeneration of the stellate reticulum" (Ivy). The dentigerous cyst forms in the mandible or superior maxilla and may form a thin projecting portion. The treatment consists in the removal of the cyst and the tooth if it is not possible to make the latter of use. "The overlying gum is dissected back in the form of a flap, some of the thin bone is removed with a knife, scissors, or rongeur forceps, and the cyst capsule is seized and gradually separated from the wall of the bony cavity" (Ivy). In most cases the cavity will have to be packed and allowed to heal from the bottom.

Rhinophyma (**rosacea hypertrophica**) is an overgrowth of the nose, particularly the sebaceous glands, their ducts, the blood-vessels, and fatty tissues. The tumor is benign but is removed because of cosmetic reasons. The lesion is removed in one or two periods by means of local anesthesia, special care being taken to control hemorrhage.

Tumors of the Tongue.—While it must be remembered that carcinoma is the commonest tumor of the tongue, many benign tumors also occur. Of these, the papilloma is the commonest. A papilloma is a wart-like tumor which occurs chiefly on the dorsum of the tongue and

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[1] Strauss, A.: Amer. Jour. Roent. and Rad. Th., 19, 265, March, 1928.

[2] Kumer, L., and Wolf, H.: Ztschr. f. Stomatol., 24, 1011, December, 1926.

[3] Weber, R.: Deutsche Monatschr. f. Zahnh., 45, 721.

[4] Ivy, Robert H.: Nelson's Loose-leaf Surgery, 2, 659, 1927.

[5] Ewing, James: Neoplastic Diseases, 3rd ed., W. B. Saunders Co., 1928, p. 759.

[6] Hopewell-Smith, A.: Normal and Pathological History of the Mouth, Philadelphia, P. Blakiston's Son & Company, 2d ed., 2, 277, 1918.

from birth to old age. It may be single or multiple. While most of them are small, enormous ones have been reported. Fitzwilliams[1] says that the diagnosis is readily made in children and in young people, it

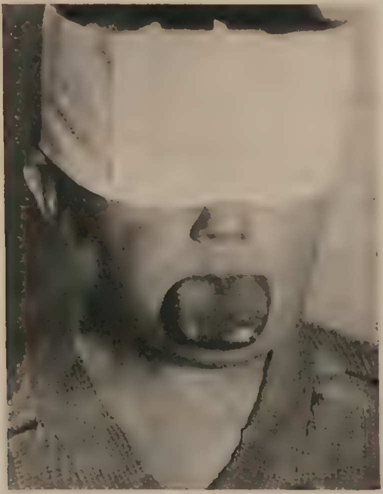

Fig. 107.—Lymphangioma of the tongue. Decreased in size following x-ray treatment. (Children's Memorial Hospital, Chicago. Courtesy of Dr. Joseph Brenneman.)

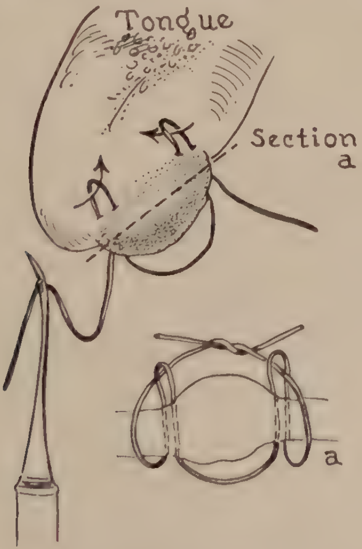

Fig. 108.—Method of removal of nevus of the tongue by the ligature method. (Redrawn after Wood.)

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[1] Fitzwilliams, D. C. L.: The Tongue and Its Diseases, Oxford University Press, 1927, p. 324.

being possible to confuse it with only a papilloma. In older cases where there is any question as to the nature of the disease the only sure procedure is to remove the papilloma with a moderate amount of healthy tissue around its base. The tissue is then examined by a pathologist.

Other benign tumors of the tongue include congenital tumors, tumors of the circulatory system (Fig. 107), lipoma, fibroma, keloid, cartilaginous and bony tumors, amyloid tumors, myxoma, rhabdomyoma, endothelioma, cylindroma, neurofibroma, and adenoma. Generally these tumors are readily excised. In the case of the larger vascular tumors the tongue is split and the portion containing the nevus is tied off (Fitzwilliams). Diathermy and electrolysis are useful. Removal by ligature is illustrated in Fig. 108. Sarcoma of the tongue is rare. A case was recently reported in a girl of sixteen years by Derman.[1]

II. MALIGNANT TUMORS OF THE HEAD

With some reason it has been objected that no malignant tumor may be included in the domain of minor surgery. The writer is inclined to believe, however, that certain circumscribed tumors of low-grade malignancy may properly be described here.

Acanthoma is a type of epidermoid carcinoma which is characterized by the presence of adult *squamous cells*, hornification, and pearly formation (Ewing). The tumors are single or may be very numerous. They are found chiefly at the mucocutaneous junctions, the face, scalp, chest, breast, back of hands, shins, and toes. There are two types of acanthoma, the less malignant and the more malignant. In the less malignant type the lesion appears as a warty outgrowth, movable on the superficial fascia. They are histologically malignant, but remain localized for a long time, and when they do spread, their direction is laterally. In this early stage, before the skin is fixed and ulcerated, the prognosis after local removal is excellent. The more malignant type of acanthomata is flat, depressed, and indurated. They early infiltrate the deeper structures and lymph-nodes, and tend to assume the structure of a tubular carcinoma. According to Ewing, "acanthoma of the skin is almost exclusively the result of chronic traumatism."

All small, warty outgrowths, particularly those at the mucocutaneous borders, should be considered as potentially malignant. If they are present in elderly individuals, and are subject to a more or less continuous irritation, they should be viewed with even more suspicion, and should be removed. The removal should be by excision in order that histological examination may be carried out. Local anesthesia is permissible, but care should be taken to keep well away from the lesion with both the injecting needle and the scalpel. Many workers believe that the best treatment of these lesions is electrocoagulation with surgical diathermy. They contend that this method offers far less likelihood of dissemination of the neoplasm during the process of removal. In a case of the writer's there was a very considerable hemorrhage following surgical diathermy, in an epidermoid carcinoma of the lip. The hemorrhage occurred when the slough separated. It has the disadvantage, however, of preventing histological examination. The treatment of the more malignant type is a major surgical problem.

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[1] Derman, G. L.: Zentralbl. f. allg. Path. u. path. Anat., 36, 150, 1925.

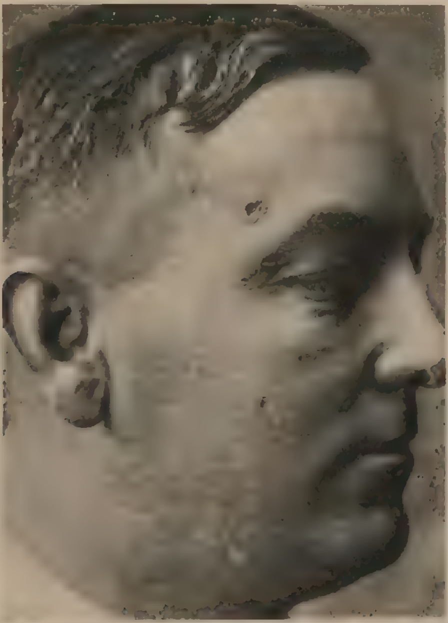

Fig. 109.—Rodent ulcer (basal-cell epithelioma). Cured by *x*-ray treatment. (Courtesy of Dr. Edward A. Oliver.)

Basal-cell Epithelioma.—The basal-cell epithelioma develops chiefly from the basal cells of the malpighian layer of the skin in distinction to the acanthoma or squamous-cell type. There are two main types, viz., the *reticulated epithelioma* or *rodent ulcer*, and the *adenoid epithelioma*. The rodent ulcer grows very slowly, does not involve the lymph-nodes, and is rarely fatal (Fig. 109). Incomplete excision is often followed by a more rapid growth. According to DaCosta,[1] a

[1] DaCosta, J. C.: Modern Surgery, 9th ed., W. B. Saunders Co., p. 339.

rodent ulcer should be excised or curetted and cauterized with the hot iron or the Paquelin cautery or subjected to electric desiccation or to electrothermic coagulation. The adenoid epithelioma shows a tendency to reproduce the dermal glands. They are more malignant than the rodent ulcer and their treatment is a major surgical problem (Fig. 110).

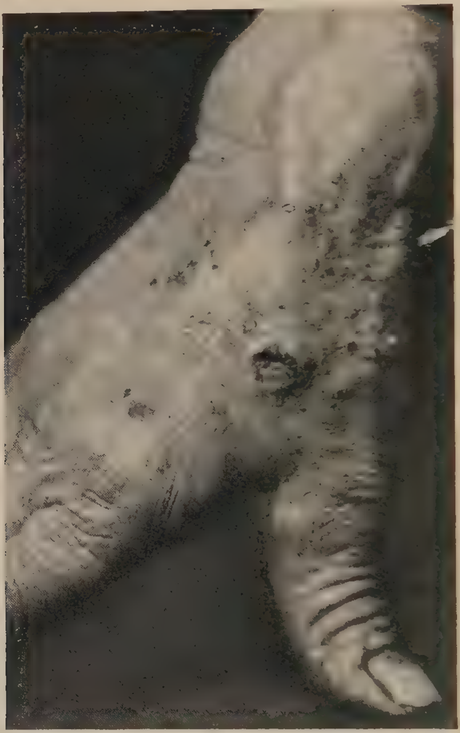

Fig. 110.—Squamous-cell carcinoma; very malignant. (Courtesy of Dr. Edward A. Oliver.)

III. CONGENITAL AND ACQUIRED DEFORMITIES OF THE HEAD

1. Congenital Deformities

(*a*) **Harelip;** (*b*) **Cleft-palate.**—Harelip, or the congenital incomplete closure of the upper lip, and cleft-palate, the congenital incomplete closure of the palate, are ailments whose difficult treatment should never be undertaken by anyone who is not specially trained in that work. The treatment certainly belongs in the realm of major surgery.

(*c*) **Tongue-tie,** or abnormal shortening of the frenum of the tongue, will result in limitation in the extension of the tongue and maybe a slight impediment to speech. This condition is readily apparent in young infants and is treated by the simple procedure of clipping the frenum. For this purpose the slotted blade of the common grooved director is useful. The blade is so introduced that the frenum passes through the slot (Fig. 111) and the frenum may thus be easily clipped. The frenum may be torn further backward with the finger. Extreme care should be taken not to cut the frenular artery or to cause profuse hemorrhage. If, however, this be occasioned one must be sure to control it before permitting the patient to leave the office.

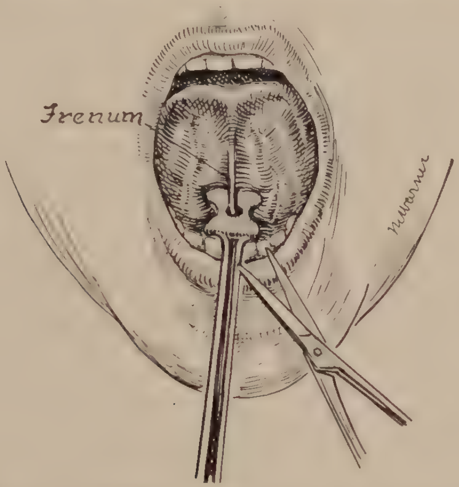

Fig. 111.—Method of clipping frenum in tongue-tie.

Hypertrophy of Gums.—In young children the gum or gingiva may become so hypertrophied at certain sites as to cause a separation of the teeth. If neglected this condition will cause a permanent, unsightly separation of the teeth, generally in the midline of the lower teeth. This hypertrophied portion of the gum should carefully be excised.

Deformities of the Ear.—(*a*) *Auricular Appendages.*—The ear is subject to small congenital protuberances at various situations on the auricle. Some of these contain cartilage. They are best treated by excision or, in the case of the smaller ones, by merely snipping them off.

(*b*) Markedly *protruding ears* may be greatly improved by the excision of a crescentic portion of skin on the posterior side which will tend to draw the auricle more closely to the skull.

(*c*) *Coloboma Lobuli.*—This is a congenital fissure of the external lobule of the ear. It may also occur as the result of a traumatism, as in women as the result of wearing heavy earrings. The slit in the ear becomes covered with epithelium and remains a permanent deformity unless treated. The edges of the slit, together with the scar tissue, should be cut away and the cut edges united with very fine sutures.

(*d*) *Enlargement of the Lobule.*—This condition is corrected by the excision of a V-shaped wedge, the base of which is at the periphery of the ear.

(*e*) *Macrotia* (*Enlargement of the External Ear: Cauliflower Ear*).—This condition may be congenital or the result of repeated traumata such as received by wrestlers and prizefighters. The most popular operation for the correction of this defect is Schwartze's, which is described by Vaughan and Burnham[1] as follows: "The operation consists in removing an elliptical segment from the pinna through its entire thickness and a triangular section from the upper portion of the ear, the base of the triangle being formed by the outer margin of the helix and the apex extending to the concha."

Thyroglossal Cysts of the Tongue.—Thyroglossal cysts may be found in the tongue. The cysts are found at the foramen cecum or, less frequently, at the base of the tongue above the hyoid bone, but "the vast bulk of them are situated below this level" (Fitzwilliams). These cysts are remnants of the embryonic thyroglossal duct and should be treated by excision. The dissection is difficult and should not be undertaken until the child is six or, better, eight years old. All but a few of the smaller superficial cysts are subjects for major surgical treatment.

Congenital fissures of the lower lip, angle of the mouth, and the outer canthus of the eye may be treated by excision of the fissure with approximation of the skin edges and the consequent obliteration of the defect.

2. Acquired Deformities

Scars.—Following burns and infected wounds there may occur the development of unsightly cicatrices in the region of the eyes and mouth.

Grattan[2] defines a scar as "evidence of prior dissolution of tissue as a result of injury, operation, or disease, followed by the process of replacement and repair." Not infrequently scars may be so unsightly as to require some effort at their removal. Various methods for this have been devised but the "triple technic of scar reduction" described by Grattan should be mentioned. The three steps are: (1) Excision of the original scar, followed by reapproximation by accurate subcuticular suturing with celloidinized silk. (2) Roentgen-ray therapy of the new hair-line scar to prevent overrepair and promote absorption. (3) Trichloracetic acid treatment of any elevations in or around the remains of the hair-line scar, to effect leveling and to eliminate "shadowing." For the details of this method, which Grattan has used in more than 1000 cases, the reader is referred to that author's paper.[1]

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[1] Vaughan, J. C., and Burnham, A. C.: Minor Surgery, Lea & Febiger, p. 176.

[2] Grattan, J. F.: Jour. Amer. Med. Assoc., 88, 638, February 26, 1927.

Hunt[2] has given a very interesting account of the treatment of *facial scars*. The pockmarks left by smallpox, chickenpox, or acne rosacea, if not too deep, are best treated by the application to the area of caustic acids, usually mixed with oil, a method known as "face-peeling." "In the excision of the scar, it is always advisable to make all incisions in healthy skin that is entirely outside of the scar tissue. If grafting is to be employed, undercutting of the surrounding tissues is undesirable, as it may invite bleeding with the formation of a blood-clot beneath the graft or transplant. If, on the other hand, it has been decided that a graft or transplant is unnecessary, and one plans merely to excise scar tissue, the more undercutting that is done, the easier it will be to correct the defect. Whatever incision is made around the scar should be made with an oblique cutting scalpel. If sutures are found to be necessary, whether between graft or transplant and the surrounding skin, or between the healthy skin edges of the wound which have been drawn together over the area formerly occupied by the defect, they should be subcuticular in character. The suture material which has given . . . the most satisfactory results is horsehair." ". . . if the wound is on the face, no dressing should be applied." In wounds elsewhere the patient should be instructed to expose the wound to the air and sunlight after the first twenty-four hours. "During the first twenty-four hours an ice-bag should be kept constantly over the operative field. This measure prevents infection and congestion with its consequent hemorrhage beneath the graft or between the wound edges. It also diminishes the pain which otherwise might be present" (Hunt). Hunt believes that the patient should be seen daily, and that at each sitting the wound should be saturated with a 2 per cent. solution of thiocyanate in physiological saline solution.

Depressed Scars.—Simple depressed scars are admirably treated by the method of Blair. The depressed area is scooped out by a curved incision and the wound thus made is carefully approximated by sutures.

Unstable Scars.—After extensive burns or the loss of tissue by trauma or operation, when the wound has been allowed to heal by the slow process of cicatrization, the wound will often break down after the slightest trauma and will be a source of greatest annoyance to patient and surgeon. For the treatment of these conditions Davis[1] has devised the method of *relaxation incisions.* His technic is as follows: "Preferably the area should be entirely healed before the incisions are made, but in some instances when the healing of the superficial ulcers has been extremely sluggish, I (Davis) have not waited for complete healing, but have operated as soon as the granulations have been brought into a healthy condition. In preparation for operation in the unhealed cases, after the granulations are healthy, the part is put up in a dressing kept wet with normal salt solution for twenty-four hours. The granulations are then painted with tincture of iodine, and the surrounding surface is cleaned with ether and alcohol. In many cases the relaxation incisions can be made after infiltration with a local anesthesia such as Schleich's solution, or 0.5 per cent. novocaine. In other instances a general anesthesia is advisable, especially if large immediate Ollier-Thiersch grafts are to be used to cover the defect. On an arm or leg, long incisions should be made parallel with the long axis of the part, down to the deep fascia; or to healthy tissue if the destruction has been deeper than the fascia. Three relaxation incisions are usually sufficient for a limb, and they result in gaping wounds. The immediate spread of each relaxation incision varies with the tightness of the scar. In some instances it is as much as 6 to 8 cm. at the center of the incision. After the tension has been relieved, the appearance of the scar tissue between the incisions soon changes and, instead of the thin, mottled, glossy look, the tissues seem to thicken and acquire greater stability. The improvement is much more marked after a few days." Davis then grafts the defects caused by the relaxation incisions.

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[1] Grattan, J. F.: Jour. Amer. Med. Assoc., 88, 638, February 26, 1927.

[2] Hunt, H. L.: Amer. Jour. Surg., 4, 313, March, 1928.

Contracted Scars.—For the removal of contracted scars it is necessary to excise the entire scar and either close the edges, or fill the defect with a skin-graft or a pedunculated flap.

Superfluous Hair.—Cosmetically objectionable hairs may be temporarily removed by an epilating wax. Pusey[2] describes a wax which is efficient for epilation and which is as satisfactory as commercial waxes. It is composed of beeswax, one part by weight, and finely powdered rosin, four parts by weight. The wax is melted over a low fire and, after melting is complete, the powdered rosin is poured in. The heat is continued and the mass stirred gently until entirely melted; this requires from one to two minutes. Pusey continues, "the method of removing hairs with the wax is as follows:

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[1] Davis, J. S.: Plastic Surgery, P. Blakiston's Son & Company, Philadelphia, 1919, p. 209.

[2] Pusey, William A.: Jour. Amer. Med. Assoc., 87, 663, August 28, 1926.

"A block, or the end of the stick, is melted by heating over a flame until it becomes soft; this can be done with a temperature that will not burn the skin. When softened, the melted wax is rubbed on the skin in the direction of the hair growth. It is well to press it down with the moistened end of the thumb, until one gets a layer about $\frac{1}{8}$ inch thick. This is allowed to cool, or is chilled by the application of ice or cool water. After it is cooled, the edge of the wax is picked up with the nail and the wax pulled off with a quick pull in the opposite direction to the growth of the hairs. This is only slightly uncomfortable. If the application has been well made—and it is easy to learn to do this—few hairs will remain on the surface. Those that do remain had best be left for subsequent application, or removal with epilating forceps. The fragments of wax that stick to the skin can be picked off or easily dissolved with carbon tetrachloride."

CHAPTER XI

INJURIES AND INFECTIONS OF THE NECK

I. INJURIES

The neck is much less liable to contusions and wounds than are the head and chest because of its relatively sheltered situation. Contusions at the neck of such severity as to cause a considerable subcutaneous hematoma may give rise to alarming symptoms because of the pressure on the trachea. Prompt incision and evacuation of the hematoma are indicated.

Falls upon the neck across hard objects may cause a fracture of the trachea or larynx. There may be abnormal mobility and a kind of crepitus. Almost constantly one finds dyspnea, blood expectoration, and emphysema of the neck. "Undoubtedly, expectant treatment, pure and simple, when there is no depression of fragments and no marked emphysema or dyspnea, is attended by very satisfactory results in a certain number of cases; but these must always be closely watched, the patient kept absolutely quiet. . . . Even after simple fissures, submucous hemorrhages and edema may cause sudden danger of suffocation; therefore the development of increasing dyspnea is always to be considered as an indication for tracheotomy, or intubation where it is practicable."[1]

The following table from Stimson shows the relative frequency with which the cartilages of the larynx and trachea are fractured:

	Cases.	Deaths.	Recoveries.
Thyroid alone	24	18	6
Cricoid alone	11	11	
Thyroid and hyoid bone	5	3	2
Thyroid and cricoid	9	9	
Thyroid and cricoid and hyoid bone	2	2	
Thyroid and cricoid and trachea	2	2	
Cricoid and trachea	2	2	
Cricoid and trachea and hyoid bone	1	1	
"Larynx"	7	3	4
Trachea alone	4	3	1

Superficial skin wounds of the neck, be they lacerated, incised or puncture wounds, are treated in accordance with the same rules laid down in the chapter on Wounds of the Head. The external jugular vein and other large veins of the neck are likely to be the cause of very profuse hemorrhage when they are wounded. The carotid artery, however, is so deeply situated that it is rarely wounded even in the most determined suicidal attempts. The writer has seen a *cut-throat wound* of the neck of such depth as to sever both the trachea and esophagus without injuring the carotid artery. Those cut-throat wounds which are high up in the neck are much less dangerous to the great vessels than those which are situated just above the sternum. The thyroid cartilage and even the hyoid bone seem to have the power of lessening the force of the wounding weapon. Few cases in which the carotid artery or jugular vein is severed are saved. Death occurs in a few minutes. Should such a person be seen immediately after the injury, digital compression may save his life. "The fingers must be thrust backward at the front edge of the sternomastoid until the great vessels are compressed firmly against the sixth cervical vertebra."[1] A finger-tip thrust into the open end of the gaping vessel may serve to control hemorrhage temporarily. Andrews[2] calls attention to the difficulty of securing a severed carotid at the bottom of a deep incised wound and says that it is often more advisable "to incise the skin at a new point and ligate the main trunk in continuity proximal to the wound." Wounds of the internal jugular or other large veins of the neck are dangerous not only because of hemorrhage but because of air embolism. Hemostasis in these cases may be accomplished by external pressure or, better, by ligature.

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[1] Lejars, F.: Urgent Surgery, 3d English ed., William Wood & Company, 1915, p. 166.

Wounds of the trachea and **larynx** are of importance because the entrance of blood into the trachea may cause hemoptysis and alarming dyspnea. Air and bloody froth rush out of the wound, and prompt intervention is required. Such cases are best treated by having the patient lie prone with the head lower than the chest. If this wound be very large it will be desirable to attempt closure under the general intratracheal or rectal anesthesia with catgut sutures. Where there is a transverse wound just above the pomum adami, Lejars advises first checking all the bleeding and then *not* introducing deep or superficial sutures but merely keeping the patient quiet with the head held in the flexed position. Where the wound is in the thyroid cartilage, this writer advises a preliminary tracheotomy and then the careful introduction of sutures which do not pass through the mucous membrane. In cases of complete transverse laceration of the trachea, the proximal end retracts and it is imperative as a first-aid measure to seize and draw this lower end out to the skin and, if necessary, fix it to the skin by sutures. Deliberate repair of the trachea may be done later.

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[1] Andrews, E. W.: Keen's Surgery, 3, 311, W. B. Saunders Co.

[2] Ibid.

Wounds of the esophagus and **thoracic duct** are too involved for such treatment as might be included in minor surgery.

Sprain of the neck involves the wrenching of the ligaments attaching the cervical vertebræ. A strain of the neck is an overstretching of the muscles of the neck. The cause in either case is the same, a violent wrench of the head from one side to the other. It may occur in children falling out of bed on the head, in football players who are tackled about the neck. The treatment of this condition is symptomatic: rest, hot fomentations, and the employment of general massage will be of value. Counterirritants, such as chloroform liniment and iodine ointments containing methyl salicylate, are also useful.

Distortions of the Cervical Vertebræ.—Blows upon the head may bring about a partial loosening of the intervertebral ligaments so as to permit a "distortion" or very slight subluxation of the cervical vertebræ. This injury is not recognized without the aid of *x*-rays of the neck taken laterally. The treatment demands rest in bed with traction by means of a halter and some 3 to 4 pounds weight for three or four weeks and generally after this a supporting leather collar. In this connection the following case is of interest.

A boy of twelve years was competing in the "plunge for distance," an event which involved his floating with his head held in the water for as long a time as he was able to hold his breath. When the limit of his endurance was reached, he jerked his head out of the water by violently extending his head. He immediately experienced some pain in the *front* of his neck. He was not seriously inconvenienced for a day or two, but with continued play and exercise his neck became more and more painful and he held it in a fixed position because of the protective spasm of the neck muscles. The *x*-ray examination showed avulsion of a very small fragment of bone from the anterior surface of the sixth cervical vertebra. The child was placed in a bed, the head of which had been elevated some 10 inches, and 3 pounds traction was put on the neck by means of a head halter. In a few days the boy was free of symptoms, and after two weeks the head traction was removed, and thereafter there was no return of symptoms.

Dislocations and fractures of the cervical vertebræ are almost invariably of such extreme seriousness as to require major surgical measures. However, very slight fractures of the cervical vertebræ without cord symptoms may be treated by halter traction described above or by a plaster cast applied with traction upon the head so as to produce extension.

Fractures of the hyoid bone are relatively rare occurrences. In 1864 Gurly[1] had collected but 27 cases. The large majority of the cases were fractures of the greater cornua. In a few cases the body was injured and in none the lesser horn. In isolated fractures of the hyoid bone the symptoms, according to Stimson,[2] are characteristic. There is "sharp pain at the seat of the fracture, increased by pressure, speaking or swallowing; swelling in the same region appearing soon after the accident and due in part to extravasated blood; recognizable displacement or mobility of the fragment; crepitus; and sometimes free bleeding from the mouth, the result of perforation of the mucous membrane of the pharynx by the bone." There is painful limitation of the movements of the tongue, and marked pain on swallowing. Reduction of the displacement should be attempted, if necessary with the assistance of a finger in the pharynx. Tube feeding and a stiff collar may be necessary.

II. INFECTIONS

1. **Cellulitis.**—Diffuse cutaneous and subcutaneous infections occur in the neck following wounds which may be very trivial. These infections are manifested by pain, swelling, and diffuse redness. There is no evidence of localization. The systemic disturbance may be rather marked with elevation of temperature and malaise. Most of these infections will yield to conservative treatment—rest, and continuous hot boric fomentations are indicated. Occasionally they will localize and an abscess cavity will form. When the induration surrounding the localization has subsided, and one may be reasonably sure that there is a well-marked defensive wall about the abscess, incision with a very sharp knife under gas anesthesia or ethyl chloride will hasten the recovery. The incisions in the neck should be made somewhat smaller than is ordinarily the case elsewhere because conspicuous scars are to be avoided. A small amount of loose gauze packing or a very small soft-rubber tube should be inserted in the wound to prevent premature superficial closure.

2. **Erysipelas** of the neck is generally secondary to that of the face or scalp, and the same rules of treatment described under erysipelas of those regions obtain in the neck.

3. **Furuncles and Boils.**—Furuncles of the neck are particularly

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[1] Gurly, quoted by Stimson.

[2] Stimson, L. A.: Fractures and Dislocations, 7th ed., Lea & Febiger, Philadelphia, 1912, p. 187.

prone to occur in men because of the irritating effect of the collar. The continued abrasive pressure of a stiff collar coupled with the presence of a staphylococcus on the surface and in the skin are liable to bring about staphylococcus infection or boils. (See section on Furuncles.)

4. **Carbuncles.**—The posterior side of the neck is the most common site of carbuncles, particularly in men. The incidence of neck carbuncles is far greater in men than in women, a circumstance which is thought to be due to the irritative action of the collar. Carbuncles of the posterior region of the neck may begin with a small localized cutaneous infection which generally has been traumatized by squeezing or picking with a needle, or it may begin as a more diffuse infection without visible wound of entry. The portal of entry which is always external is most commonly a hair-follicle. The rate of progress of development of the carbuncle depends on the virulence of the invading organism. Some types of hemolytic staphylococcus will make a very severe lesion with marked systemic prostration, elevation of pulse and temperature, and a wide area of induration on the neck. There may be little, if any, pain and no visible evidence of localization. It is justifiable to treat very early carbuncles of the neck by hot fomentations and unguents for a period of perhaps twenty-four hours. If *marked* encouragement is not obtained radical surgery is by far the safest course. In smaller carbuncles the crucial or sexagonal incision with generous undercutting of the flaps and excision of the necrotic tissue will suffice. For larger carbuncles the double cross incision with removal of the central square will be advisable. For the details of the treatment of furuncles and carbuncles of the neck the reader is referred to the chapter on Furuncles and Carbuncles.

5. **Ligneous Phlegmon; (Woody Phlegmon; Reclus' Disease).**—Ligneous phlegmon was first described by Reclus in 1894. It is an extremely chronic suppurative inflammation of the subcutaneous tissues of the anterior and lateral portions of the neck. Over weeks and even months a board-like hardness and induration develops. For a considerable period of time the usual signs of inflammation are absent. In advanced cases the larynx, trachea, and floor of the mouth are involved. There is little pain but the movements of the neck are restricted because of the stiffness. Collections of pus will finally become evident. The etiology is obscure. According to Freeman,[1] the "diagnosis is difficult, as may be appreciated from the fact that ligneous phlegmons are nearly always mistaken for carcinomatous or possibly tuberculous infiltrations

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[1] Freeman, Leonard: Keen's Surgery, 1, 263, 1916, W. B. Saunders Co.

arising from the cervical glands. Even the advent of suppurative foci does not always settle the question, as these appear sometimes in connection with cancer; so that in order to be certain in such a case one would have to wait until the patient recovered, which might require three or four months." The treatment is unsatisfactory. Individual abscesses are opened as they present themselves. Hot fomentations may hasten the formation of these abscesses.

6. **Deep Infections of the Neck.**—The majority of deep infections of the neck are of such a serious nature that their consideration is more properly placed in major surgery. The patients are very ill. There may be dysphagia and dyspnea. There is pronounced swelling of the region, but the overlying skin, while edematous, is rarely red. The swelling is very hard and it is very unusual to detect fluctuation because of the tense deep cervical fascia. There is pain upon pressure. While certain of these deep infections may subside spontaneously or may be localized, if there is no improvement after twenty-four hours of poulticing or hot dressings, operation is indicated. (See case on p. 19.) In submaxillary infections the lateral incision is the best (Colp). "But in deep infections, especially those of the sublingual space, the lateral incision parallel to the mandible must do more than divide the deep cervical fascia of the neck. It must divide the mylohyoid muscle from its free lateral border to the median raphé, cutting if necessary the anterior belly of the digastric muscle near its mandibular attachment. This incision affords free drainage to the sublingual space with very little danger of injuring the ranine vessels, Wharton's duct, or the sublingual glands."[1] Where the abscess is lower, the E. Wyllys Andrews incisions may be used, anterior or posterior to the sternomastoid muscle. The sternomastoid muscle may be split or even removed. In the submaxillary infections Colp strongly advises the extirpation of the submaxillary gland. To the writer the employment of ethylene or nitrous oxide gas is the anesthetic of choice. Colp, however, says that "it is obvious that local anesthesia is a sine qua non in all these operative procedures."

7. **Cervical Adenitis or Lymphadenitis.**—The lymph-nodes of the neck are subjected to either acute or chronic inflammation. Some of the acute inflammations are sequelæ of respiratory or tonsillar infection and occur most commonly in young children. Others are caused by small superficial wounds or by furuncles and boils. The first measure to be employed in the treatment is to search for the focus of infection. Appropriate sprays and gargles should be used for the respiratory infections.

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[1] Colp, Ralph: Amer. Jour. Surg., 2, 530, June, 1927, N. S.

Small wounds should be treated by hot boric fomentations if infected, and the furuncles and boils should be treated along the lines laid down previously. In the usual case which follows a respiration infection there will be present a swelling on the side of the neck which is well below the parotid region, generally below the ear, and either anterior or posterior to the sternocleidomastoid muscle. This swelling is hard, somewhat tender, and the overlying skin is not discolored. At this stage the accepted treatment is the continuous use of an ice-collar. The ice-collar should be enclosed in a sock which has had the toe cut off or wrapped in a towel when it is more acceptable and better tolerated by the patient. Many such cases of adenitis will subside spontaneously with the use of cold applications. The length of time required for the subsidence of those cases which are amenable to cold is variable. As long as three weeks may occasionally be necessary. It is important that the skin be frequently inspected and that occasional respites from the ice packs be given to minimize the danger of frost-bite.

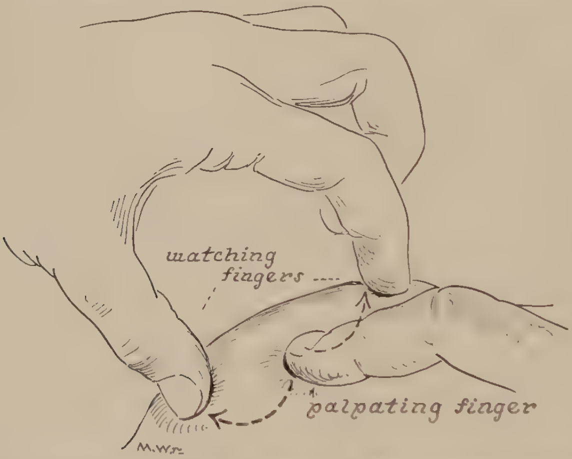

Fig. 112.—Test for fluctuation. The "watching fingers" are held stationary, and will appreciate movements of fluid initiated by the palpating finger.

In some cases, despite the most energetic use of ice, it will be seen that the process is localizing. The area of induration will become less, the superficial skin will become red, and the swelling is more sensitive to palpation. When this has occurred, it will be useless to continue with the cold treatment and a hot treatment of hot packs or hot-water bag is indicated to accelerate the localization of the process. Premature or ill-advised incision of such abscesses is to be avoided. It will be well to wait until fluctuation definitely has been established. The *test for fluctuation* should be done by placing two fingers at the margins or near the margins of the swelling. These fingers have been spoken of as the "watching fingers." Over the convex prominence of the swelling a third finger is placed. This is the palpating finger. Gentle pressure by the palpating finger will often produce a fluid wave which is appreciated by the lateral "watching fingers" (Fig. 112). The diagnostic aspiration of the swelling is unnecessary and, moreover, is attended by some danger. During the poulticing or expectant treatment the child should carefully be watched (Fig. 113). If there be increase in the systemic disturbance, increase in the area of induration, or difficulty in swallowing or breathing, one should *never* wait for localization to progress. A child of six months showed a painful swelling on the side of the sternocleidomastoid muscle. After two or three days of observation this swelling was noted to be prolonged downward to the supraclavicular region. Immediate intervention was determined upon and an incision was made parallel to the anterior border of the sternomastoid muscle and pus evacuated from a large abscess cavity which pointed downward behind the clavicle toward the mediastinum and upward along the carotid sheath. The surgical treatment of these abscesses requires that the use of sharp dissection be strictly limited to the more superficial regions. After the skin and subcutaneous tissues have been incised it will be well to divulse the underlying tissues by means of a hemostat or a blunt-pointed scissors. By carefully proceeding in this manner the abscess cavity will be broken into. The opening into the cavity should be widely spread

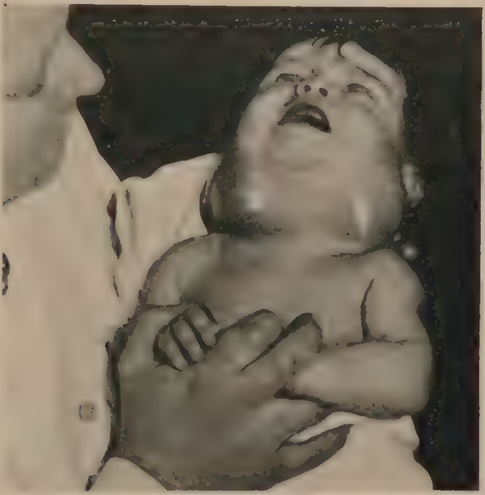

Fig. 113.—Suppurative cervical adenitis. (Children's Memorial Hospital, Chicago. Courtesy of Dr. A. H. Montgomery.)

and a small amount of gauze packing loosely inserted. The purpose of this packing is to maintain the superficial opening until discharge has finished and the cavity has filled up by granulation tissue from the bottom. It will be well to change this packing daily. A soft-rubber tube occasionally is of service and may be sutured into the wound with one catgut suture, but care will be necessary to prevent the rubber tube from pressing on the carotid artery or jugular vein or other important structures, because of the fear of pressure erosion. After the abscess cavity has been adequately opened and drained the supplementary use of hot boric fomentations will hasten the recovery. When the abscess cavity has become very small and the inflammation has subsided, it will be unnecessary to continue the insertion of drains. A dry dressing generally will suffice.

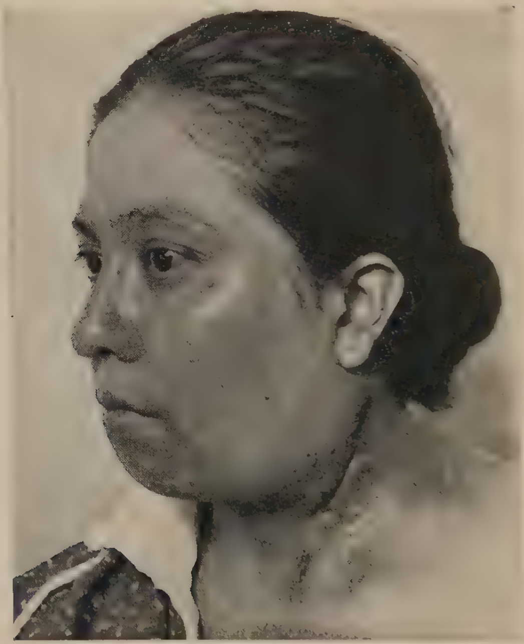

Fig. 114.—Tuberculous cervical adenitis with discharging sinuses. (Courtesy of Dr. Edward A. Oliver.)

Chronic cervical adenitis may be due to the delayed resolution of acute cervical adenitis or it may be due to tuberculosis. In the case of the former the history generally will furnish the diagnosis. In the case of the latter a general physical examination will furnish the clew. The cases of *tuberculosis of the cervical lymph-nodes* are treated by conservative measures (Figs. 114, 115). Rest, abundant food, fresh air, and sunshine will most often cause these swellings to melt away. Where this is impracticable the use of ultraviolet radiation of the entire body is often of benefit. The surgical excision of tuberculous "glands" of the neck is of much less frequent occurrence than formerly, save in cases of fluctuant abscesses. These are incised, drained, curetted, swabbed with iodine, and packed. Clute[1] has made an interesting study of some 140 cases of tuberculosis of the cervical lymph-nodes. There was no mortality in the series. The best results were obtained in the cases which came early for treatment and in some cases a combination of *x*-ray treatment and surgery gave good results. It is important to remove all sources of infection, as diseased tonsils, abscessed teeth, etc. Nerve injuries occurred with diminishing frequency with better understanding of the anatomy. This author believes that the surgical treatment is the procedure of choice for the average patient who cannot afford the time or expense of prolonged hygienic treatment.

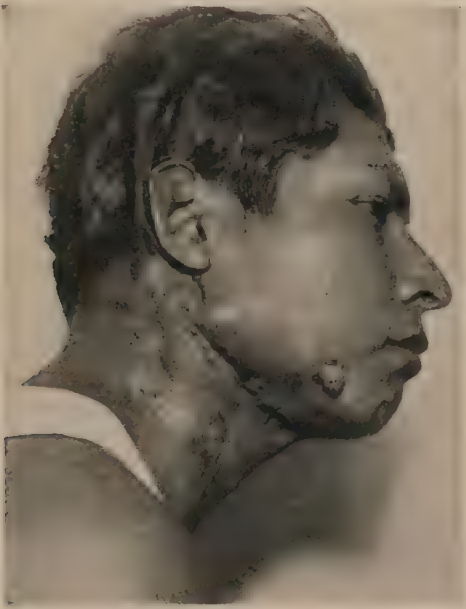

Fig. 115.—Old tuberculous glands of the neck with tuberculosis of the skin and scarring. (Courtesy of Dr. Edward A. Oliver.)

8. **Suppurative Parotitis.**—Pyogenic infections in the parotid gland may localize and cause the gland to break down and suppurate. When this occurs the abscess will be treated by incision and drainage, as is any other abscess. Care must be taken, however, to cause a minimum

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[1] Clute, H. M.: Ann. Surg., 86, 666, 1927.

amount of damage to the substance of the parotid gland because of the likelihood of a parotid fistula resulting. Should a parotid fistula occur, it will generally heal spontaneously unless by mischance the parotid duct has been injured. The contraction of the healing wound together with the effects of suppuration will bring about the atrophy of the affected cells of the parotid gland.

9. **Specific Infections of the Neck.**—Of the specific infections which involve the neck, tuberculosis, syphilis, anthrax, and actinomycosis have been considered previously.

Ludwig's angina (*angina ludovici*) is an acute purulent inflammation of the floor of the mouth which usually is due to the streptococcus. The symptoms are those of a severe sepsis, with the formation of a tense brawny swelling in the submaxillary region. There is great pain, dysphagia, difficulty in swallowing, and sometimes dyspnea. The treatment demands early incision. The prognosis in the more advanced cases is grave.

10. **Arthritis of the Cervical Spine.**—Patients complaining of painful neck and presenting tender points along the transverse processes of the cervical spine and limitation of motion, should be investigated for the existence of arthritis of the cervical spine. The diagnosis of arthritis of the cervical spine is confirmed by the *x*-ray, which will show some lipping of the vertebræ or the presence of calcareous deposits of the intervertebral ligaments and upon the vertebræ themselves. The treatment of arthritis of the cervical spine is two-fold, local and general. The main features of the local treatment are rest and heat. Rest is best obtained by putting the patient to bed with the application of traction upon the neck. The head of the bed is elevated from 4 to 6 inches, a canvas halter is placed beneath the patient's chin and occiput, and attached to a spreader which in turn is attached to a rope passing over a pulley and from 3 to 5 pounds weight is applied to produce traction. While the traction is being maintained the attendant should be instructed to apply continuous moist heat to the neck. This is best accomplished by first placing upon the pillow an electric pad. Upon the electric pad is placed a rubber sheet or other waterproof material. Upon this in turn is placed an abundant quantity of gauze or flannel. The flannel or gauze is moistened at regular intervals with boric solution or a solution recommended by Dr. Philip Lewin, which contains:

Tr. opii	30
Liq. plumbi subacetatis dil	40
Phenol ½ of 1 per cent	50
Extr. hamamelis	60

The systemic treatment involves a careful search for possible foci of infection. All carious teeth should be removed and those suspected of having root abscesses should be *x*-rayed and, if present, the teeth should be extracted. If the tonsils present evidence of infection they should be removed. The sinuses, particularly the ethmoids, should be carefully examined by a rhinologist and given appropriate treatment if necessary. Infection in the middle ear should be searched for and treated. Chronic infection of the appendix or gall-bladder may play a rôle. Of particular importance is the recognition of the intestinal tract, which may be regarded as a focus of infection. To this end anti-constipation treatment should be instituted. It is a common occurrence to be assured steadfastly by the patient that he has a daily bowel movement but, in the words of Paul Magnuson, "the train may be on time but a day late." It will also be well to curtail the amount of protein ingestion.

FIRST AID IN MAJOR SURGICAL INJURIES OF THE NECK

In cut-throat wounds the first-aid treatment will involve the control of hemorrhage. If the jugular vein or the carotid artery be cut, an effort should be made at once to ligate them, if necessary using unsterile ligatures. Where the trachea and esophagus both have been cut, the first-aid treatment is directed toward the prevention of asphyxia from the inspiration of blood or vomited stomach contents. To this end the head and neck of the patient are placed at a lower level than the body.

In cases of suspected fracture of the cervical vertebræ with the head fixed in an unnatural or semirotated position, or where there may be a paralysis of the extremity following a fall upon the head as in diving, the first-aid treatment is directed toward the transportation of the patient to the hospital, with the minimum amount of disturbance to the neck. It is desirable to move the patient so that the head, neck, and trunk move as one piece. An ill-advised attempt to change the position of the head may mean instant death.

CHAPTER XII

TUMORS AND DEFORMITIES OF THE NECK

Benign Tumors.—The neck is the site of certain benign tumors. Lipoma, hemangioma, and lymph cysts occasionally are found. Lipomata are readily removed under local anesthesia (see p. 207). Hemangiomata are very vascular and their removal is fraught with some danger. It can more properly be considered as a major surgical problem (see p. 205).

Lymph cysts are congenitally dilated lymph vessels and, according to Hertzler and Chesky,[1] they are seen more often in the neck than any other region. They have a soft consistency but are not compressible like angiomata. Complete cure requires excision, which may require an extensive dissection.

Dermoid cysts and **sebaceous cysts** have been found in the neck and are removed in the usual manner (see p. 193). **"Hair" cysts** are those small inclusions which are due to the ingrowing of the shortly cut hair. The hair will often curl up upon itself intracutaneously and attain a length of 1 cm. or even several inches (Vaughan and Burnham). The extraction of the hair by needle or forceps is generally all that is required for treatment. Where the cyst is large, it should be opened under local anesthesia and its lining swabbed with iodine.

Hygroma ("Lymphocele").—Hygroma cysticum has been described by Ewing[2] as a circumscribed form of congenital lymphangiectatic elephantiasis appearing in the neck, sacral and perineal regions of fetuses, infants, and children. "All structures of the skin may be involved and there is increase of connective tissue diffusely and about nerves, vessels, and glands" (Ewing). The tumor which is generally considered to be nonmalignant is usually on the lateral aspect of the neck (Fig. 116). The swelling is soft and varies greatly in size. It is composed largely of dilated lymph-spaces filled with a serous fluid. These may break into each other. In the case of small cysts excision may be carried out. Vaughan and Burnham state that spontaneous cure is frequent. Alcohol injections are occasionally successful.

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[1] Hertzler, A. E., and Chesky, V. E.: Minor Surgery, C. V. Mosby Company, 1927, p. 237.

[2] Ewing, James: Neoplastic Diseases, W. B. Saunders Co., 3d ed., 1928, p. 171.

Swellings of the thyroid gland are generally spoken of as goiter. They may, however, be due to cysts of the thyroid. All examinations of the thyroid gland are best done by having the patient seated and, standing behind the patient, palpating the anterior surface of the neck. By this method an appreciation of the shape and consistency of the swelling may better be obtained. The patient is instructed to swallow and if the swelling rises and falls with deglutition, it will be known that it is overlying and attached to the trachea. Swellings which do not rise and fall are attached to the skin. Small cysts of the thyroid gland without systemic disturbances may be removed under local anesthesia. The operation, however, is attended by considerable difficulty because it will be necessary to incise the cervical fascia and to retract laterally the sternohyoid and sternothyroid muscles. All types of goiter are outside the field of minor surgery. This statement likewise applies to the aberrant goiters, parotid tumors, muscle tumors, and tumors of the submaxillary and sublingual glands. Malignant tumors also belong to the domain of major surgery. Among these may be enumerated, as most common, carcinoma, epithelioma, sarcoma, lymphosarcoma, Hodgkin's disease, and metastatic tumors. Sweet[1] reported the case of a goiter in a newborn child which at the time of delivery was about one-third the size of the infant's head. The goiter disappeared in nine weeks after feeding the nursing mother iodized calcium lactate.

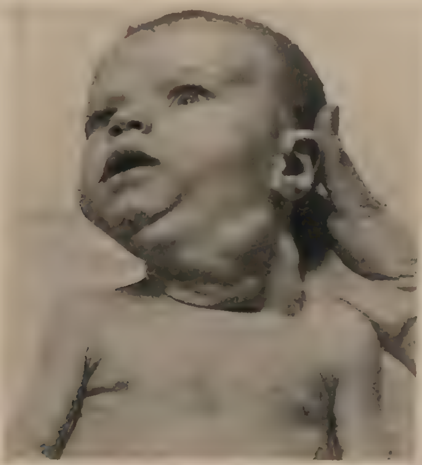

Fig. 116.—Hygroma. Treated by radium and reduced in size when child was removed against advice. (Children's Memorial Hospital, Chicago. Courtesy of Dr. Joseph Brenneman.)

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[1] Sweet, P. W.: Northwest Medicine, 1928, 27, 183.

CONGENITAL AND ACQUIRED DEFORMITIES OF THE NECK

1. Embryonal Cysts and Fistulæ of the Neck.—(*a*) *Lateral Cervical Cysts and Fistulæ* ("*Branchiogenic Cysts and Fistulæ*").—Cysts and fistulæ which are found on one or both sides of the midline of the neck, generally about $1\frac{1}{2}$ inches from the midline, are spoken of as lateral cervical fistulæ and cysts. Formerly these anomalies were described as branchiogenic cysts and fistulæ, but the recent work of Wenklowsky[1] has cast some doubt upon their being of branchiogenic origin and suggests quite strongly that they are derivatives of the embryonal thymic duct. A cyst will be manifested by a small rounded nodule in the neck which, if large enough to palpate, may be shown to have fluctuation. The fistulæ may be complete, that is, extend from the buccal cavity to the outside of the neck, or they may be incomplete, extending from the subcutaneous tissues to the skin or from the subcutaneous tissues to the mouth. The cyst gives practically no symptoms except its rather unsightly appearance. The fistulæ are complained of by the patient because of the continual discharge on the surface of the neck. A drop of watery pus is practically always present at the orifice of the fistula. Cases have been reported in the literature where the fistula was of such size, patency, and length that bread crumbs and other particles of food found their way down from the mouth out on the surface of the skin at the neck. The lateral cervical cyst generally may be removed under local anesthesia without great trouble. The excision of the fistula may also present considerable difficulty and be a major surgical problem.[2] The procedure generally employed is to inject the sinus with methylene blue and by cautious dissection excise it up to the buccal cavity and there cut it off and turn the stump into the mouth and fix it there by a purse-string.

(*b*) *Thyroglossal Cysts and Fistulæ.*—Cysts and fistulæ in the midline are generally remnants of the embryonic thyroglossal duct, although sebaceous cysts have been found in this location. Payne[3] believes that the recognition of thyroglossal cyst "should be easy for it always occurs in the midline between the symphysis mentis and the thyroid cartilage. It should, however, be differentiated from ectopic thyroid tissue, enlarged submental gland, inclusion dermoids which are always found in the median line, lingual dermoids, submental cysts which develop from the cervical sinus and often called ranula, and lastly from the true cervical fistula which is of branchiogenic origin and always situated lateral to the midline along the anterior border of the sternomastoid muscle." The treatment of thyroglossal cysts and fistulæ is identical with that of lateral cysts and fistulæ. Eliason[1] reports five inclusion cysts of the hyomandibular region and gives a very interesting account of their embryology (Figs. 100 and 101).

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[1] Wenklowsky, R.: Arch. f. klin. Chir., 1912, 789.

[2] Christopher, F.: Surgical Treatment of Lateral Cervical Fistulæ, Surg., Gynec. and Obst., March, 1924, p. 329.

[3] Payne, R. L.: Amer. Jour. Surg., July, 1927, N. S., 3, 1.

2. **Cartilaginous Nodules.**—Embryonic cartilaginous remnants may be found in the skin of the neck or as accessory appendages to the ear. Their removal is safely and easily accomplished under local anesthesia.

3. **Cervical Rib.**—Patients presenting themselves with the complaint of continual pain running down the arm, particularly that which has a constant area of distribution, will suggest the presence of a cervical or supernumerary rib. The presence of such a rib is determined by x-ray examination. The removal of the rib is a problem of major surgery,[2] but in the diagnosis it is important to differentiate this condition from brachial neuritis. Leri[3] states that as the normal variation of the processes is very wide, care must be taken in ascribing nerve disturbances of obscure origin to cervical rib or hypertrophied transverse process.

4. **Torticollis or Wry-neck.**—Wry-neck is a condition in which there is a shortening of the sternocleidomastoid muscle and its associated structures. Fraser[4] describes six varieties as follows:

"1. *Congenital wry-neck*, in which the error becomes apparent shortly after birth and progressively increases in degree.

"2. *Acute wry-neck*, in which the muscle is the site of a primary or of a secondary infective involvement.

"3. *Traumatic wry-neck*, in which injury to the muscle or its associated structures has resulted in the formation of fibrous tissue and subsequent shortening.

"4. *Spasmodic wry-neck*, in which a nervous error is responsible for an intermittent or spasmodic contraction of the sternomastoid and it may be of associated muscles.

"5. *Postural wry-neck*, arising secondary to deformities of the spine, or in compensation for an ocular error.

"6. *Paralytic wry-neck*, following paralysis of the trapezius and sternomastoid muscles. The usual cause is the division of the associated nerves during operation for tuberculous cervical glands.

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[1] Eliason, E. L.: Therap. Gaz., 50, 238, 1926.

[2] Adson, A. W., and Coffey, J. R.: Ann. Surg., 85, 839, June, 1927.

[3] Leri, A.: Presse méd., Paris, 1924, 32, 857.

[4] Fraser, John: Surgery of Childhood, William Wood & Company, New York, 2, 620, 1926.

"All varieties are met with in childhood, but the congenital type forms the great bulk of the cases."

The etiology is obscure. Heredity probably plays a part. The various theories of explanation include the traumatic theory, the infective theory, the theory of intra-uterine disease, the nerve paralysis theory, and the very reasonable theory that the process is similar to an ischemic or Volkmann paralysis. In the slight cases of congenital wryneck the child should be given massage and movement to stretch the shortened muscle at once. In the more marked cases operation should be done when the child has reached the age of one month, if he is seen at that time. Subcutaneous tenotomy or open myotomy will be done. In the former operation each head of the sternomastoid is divided close to its sternoclavicular insertion. The cut is from within outward, and the muscle is held tense during the operation. In the latter operation the procedure is much the same except that the open operation enables the cutting to be done under direct vision and there is less danger of damaging the underlying internal jugular vein. After operation a corrective bandage is applied for two weeks and this is followed by a brace collar for six months. The collar is removed daily for active and passive movements.

5. **Cicatrices.**—Scars of burns caused by heat, electricity, chemicals, or *x*-ray will cause a contracture; and if on one side of the neck will pull the head to one side, or if under the chin, will cause the chin to be drawn downward. The excision of this scar tissue and the subsequent grafting of skin to replace the excised portion often is a major surgical problem of greatest complexity. (See section on Scars.)

CHAPTER XIII

INJURIES AND INFECTIONS OF THE TRUNK

I. INJURIES OF THE TRUNK

1. **Contusions.**—The trunk is particularly liable to contusions and bruises. All contusions of the chest and of the abdomen must be regarded as potentially serious because of the possibility of damage to the deep underlying organs. Severe bruises of the chest wall may be extremely painful and may cause the development of a hematoma or extensive ecchymoses. Should a hematoma develop it will be well to aspirate it under aseptic precautions and to supply a snug bandage. Contusions of the back with extensive bruising of the large muscles of the back are extremely painful and require rest in bed, application of heat and of mild counterirritants.

All *contusions of the abdomen* must be regarded as serious. Of prime importance is the taking of considerable pains to get an accurate history of the accident. If there is any reason to believe that an automobile has passed over the abdomen or if the patient's abdomen has been subjected to a heavy crushing force, as having been squeezed between two cars, kicked by a horse, or having had a heavy weight fall on the abdomen, the case should be handled with greatest circumspection. It must be remembered that in severe bruises of the abdominal wall there will be a marked degree of pain and rigidity, which very closely will simulate an intra-abdominal injury. The diagnosis of intra-abdominal injuries cannot be made upon abdominal pain and rigidity alone; elevation of the leukocyte count and of the pulse-rate, the presence of shifting dulness, vomiting, pallor, and the degree of shock (low blood-pressure) are factors which will help decide the question of whether or not surgical intervention is indicated. Increasing and spreading rigidity is more suggestive of visceral than parietal damage, and is more marked in rupture of hollow viscera and its consequent peritonitis than in laceration of solid organs and hemorrhage. Levin[1] calls attention to the great value of fluoroscopic examination of the abdomen in revealing free gas in the peritoneal cavity from rupture of the intestines.

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[1] Levin, I. M.: Ann. Surg., 87, 718.

A very frequent cause of accident to young children is their being struck by automobiles which are being backed out of the garage driveways. A child of six years was brought into the hospital in some shock with a history of being struck in this manner. The person driving the car stoutly maintained that she felt the wheels bump over the child's body. Abrasions upon the head prompted the making of a roentgenological examination which revealed a fracture of the vault of the cranium. A fracture of the right clavicle was easily discovered. The chief point of interest from the diagnostic standpoint was the child's marked abdominal rigidity and tenderness. No one could positively state that a wheel had *not* passed over the abdomen. The question of a laparotomy was seriously considered but upon advice of surgical counsel operation was deferred and an expectant plan of treatment was followed. This course fortunately was attended with complete success and the child recovered. The responsibility of withholding of laparotomy in the presence of a severe abdominal contusion with pain and abdominal rigidity should certainly be shared by a consultant.

The treatment of intra-abdominal injury is a difficult major surgical problem.

Of interest in connection with the consideration of contusions of the abdomen are the cases of *rupture of the deep epigastric artery.* In many of these cases there is a history of preceding trauma. In other cases, such as the two reported by Epstein[1] and the one by Culbertson,[2] the rupture of the deep epigastric vessel appears to have been spontaneous. In MacLennan's[3] case the entire arterial system showed an advanced stage of arteriosclerosis. This patient died five days after the onset of the condition and four days after operation. In all these cases the onset is characterized by agonizing pain, and generally by swelling.

Contusions of the flank will not infrequently cause a traumatism of a kidney. The existence of a superficial abrasion in the flank following a crushing injury, and accompanied by the presence of blood in the urine, will establish the diagnosis. These contusions of the kidney are generally benign and require no other treatment but rest. The more severe injuries with marked hematoma and possible extensive laceration of the kidney itself will require major surgical treatment which may include nephrectomy.

Injury to the urinary bladder should always be suspected in patients who have been subjected to crushing injuries. It is not uncommon in children. Greene[1] reported 2 cases with their appropriate major surgical treatment.

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[1] Epstein, H. B.: Amer. Jour. Surg., May, 1927.

[2] Culbertson, C.: Jour. Amer. Med. Assoc., 85, 1955, 1925, quoted by Epstein.

[3] MacLennan, D.: Brit. Med. Jour., i, 895, 1928.

Contusions of the breast in women are painful but are rarely accompanied by serious consequences. Practically every women who develops cancer of the breast will remember having been struck in the breast at some time or other, but, as this naturally happens to almost all women, it cannot seriously be regarded as an etiological factor in cancer. A breast which has been severely bruised and which contains a large amount of suffused blood will be made more comfortable by a breast binder which elevates and compresses the breast.

All *contusions of the chest* should be considered as possibly being accompanied by fracture of the rib or scapula and investigation should be carried out to determine if this be the case. (See Fractures of Ribs and Clavicle.)

Contusions of the back are often accompanied by severe pain due to the bruising of the large muscles of the back. Any effort to move causes intense pain, and there is localized tenderness upon pressure. The tender areas are over the muscles, and pressure upon the spinous processes may be painless. One should not conclude that there is no bony injury because there is no tenderness upon the spinous processes, and suspicious cases should always be *x*-rayed. The treatment of uncomplicated cases consists of rest, heat, and gentle massage.

2. **Wounds.**—(*a*) *Superficial Wounds.*—Abrasions, lacerated wounds, and incised wounds are treated along the general lines laid down for the treatment of these wounds as recounted in the chapter on Open Wounds. In the case of puncture wounds one must observe the same degree of judgment as to whether or not to administer tetanus antitoxin as applied elsewhere. (See p. 48.)

(*b*) *Penetrating wounds* are those which not only wound the external skin but also some underlying organ. In the chest the pleural cavity may be invaded. If the offending weapon be a small sharp knife and does not damage appreciably the lung substance, the wound will close on its withdrawal and no great harm will be done. If, however, the lung substance is damaged considerably, a hemothorax will develop. This may be ascertained definitely by the use of *x*-ray, and the treatment in practically all cases will be expectant. If the wound in the chest wall be large and gaping, a "*sucking*" *wound* will result, due to the passage to and fro of the air in the pleural cavity and the outside air. The danger of collapse of the lung in these cases is very marked and the surgeon should endeavor as soon as possible to close the wound tightly even if the air be left in the pleural cavity. Duval[1] found that 50 per cent. of all the fatal war lung wounds died within the first day. Lilienthal thinks it not unlikely that this high death-rate may be the result of the pressure disturbances incidental to an open pneumothorax. The first-aid treatment of a "sucking wound" is the closure of the wound by suture, by closing the skin with adhesive straps, or by the application of an occlusive wet dressing.

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[1] Greene, L. B.: Ann. Surg., 87, 307, 1928.

Penetrating wounds of the chest may also enter the pericardial cavity with or without wounding the heart. The treatment of such wounds belongs to the realm of major surgery.

Penetrating wounds of the abdomen may cause no damage whatsoever to the intra-abdominal viscera but the extreme likelihood of a visceral wound will demand an exploratory laparotomy (major surgery).

3. **Sprains of the Back.**—The examination of the injured back should be conducted in a methodical manner. A very valuable guide to such an examination is the following form, for which permission to publish was very courteously given by its author, Dr. R. C. Webb, Chief Surgeon of the Great Northern Railway.

GREAT NORTHERN RAILWAY COMPANY

(Supplementary Surgeon's Report of Back Injury)

1. Report of accident to. At or near.
2. On (date). 19——. Address.
3. Occupation? Age. Date of this report.
4. CAUSE OF BACK INJURY:
    If caused by a blow, get an accurate location of place struck.
    If caused by lifting, determine exact position of patient at time.
    Determine if leverage was unilateral by finding out which foot slipped or on which side the weight came most heavily.
    If caused by being thrown or twisted, get as accurate a description as possible.
    If caused by a fall from a height, determine exact position at time of landing.
    Leverage causing back injury may be from above or below, or both.
5. INDICATE AND DESCRIBE THE PATIENT'S LOCATION AND DISTRIBUTION OF PAIN. (Skeleton figure of thorax is part of the form.)
    Indicate the location of the pain by placing the letter "x" over the various spots indicated by the patient.
    Indicate the distribution of the pain by drawing arrows from the various letters in the direction and to the points where the pain is said to radiate.
    Amplify this description by giving the patient's own words of description.
6. DOES PATIENT DESCRIBE DISTRIBUTION OF PAIN TO EXTREMITIES? If so, give a detailed report in patient's own words of exact area on the lower extremities to which the pain is referred, indicating right or left, etc.
7. GIVE THE PATIENT'S DESCRIPTION OF THE POSITION IN WHICH HE IS THE MOST COMFORTABLE.

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[1] Duval, quoted by Lilienthal: Review of War Surgery and Medicine, Office of the Surgeon General, Washington, 1918, No. 4, 1–27.

8. Give the Patient's Description of the Positions which Cause the Most Discomfort.
9. What Actions Cause the Most Discomfort?
10. Physical Examination of the Back. (All clothing removed.)
    - (*A*) Inspection:
        - Describe any marks or ecchymoses or swelling. Is there a list to one side or the other? Describe.
        - Describe any curvature, kyphosis, or other abnormality.
    - (*B*) Palpation. Compare the lumbar muscles as to muscle spasm. Palpate the following points of tenderness:
        - (*a*) Inferior sacro-iliac ligaments.
        - (*b*) Sacrosciatic notch where superior gluteal nerve curves around.
        - (*c*) Sciatic nerve-trunk at level of the gluteal fold and below.
        - (*d*) Mesial to and lateral to the posterior spine of the ilium over origin of the iliolumbar ligaments and iliocostalis muscle.
        - (*e*) Spinous processes and interspinous ligaments of the fourth and fifth lumbar and first sacral.
        - (*f*) Dorsum of sacrum and articular facets of fifth lumbar and first sacral.
        - (*g*) Record tenderness if present in any other area.
    - (*C*) Motions of Back—Standing, Sitting, and Lying:
        - (1) *Standing—Knees Stiff.* Flexion of spine forward. Is lumbosacral region rigid upon forward bending at hips with forward flexion of the upper lumbar and dorsal regions?
            - Does he flex the lumbar spine until the hamstrings become taut and then stop because of pain or flex the knee?
            - Extension of the spine backward. Does he keep lumbar spine rigid and bend backward by bending his knees with little or no motion in the lumbosacral region?
            - Is there distinct motion in the lumbar spine with tilting of the pelvis backward and free performance of this motion?
            - Lateral motion or side bending. Is there limitation of motion at lower lumbar and lumbosacral region?
            - Is the motion only in the dorsal and upper lumbar spine?
            - Is the motion freer away from the affected side or toward it?
        - (2) *Sitting in Chair with Knees Flexed.* (Hamstrings relaxed.) Are attempts at flexion of the spine just as limited as in the standing position?
            - Does patient bend forward freely?
            - *Sitting on Table with Knees Straight.* (Hamstrings taut.) Are standing flexion tests confirmed?
        - (3) *Motions Lying.* (Passive flexion of the lumbar spine by the examiner actively flexing both hips first with knees flexed and second with knees straight.) Is pain produced when knees are flexed?
            - Is pain produced when knees are straight?
    - (*D*) Special Tests:
        - (*a*) Straight leg raising, one side at a time, raising leg slowly with one hand under lower spine, beginning with side complained of.
            - Is pain produced as hamstrings are taut and before the lumbar spine begins to move?
            - Is pain produced only after the lumbar spine begins to move?
            - In raising the opposite leg, does pain come at the same level?
            - Can the opposite leg be raised to a higher level before pain is produced?

(*b*) Compression of the crests with patient lying on the unaffected side. With the forearm on the crest of the affected side the examiner leans on it for about one-half minute. Is pain produced?

(*c*) Does pressure over pubes with patient lying on back produce pain?

(*d*) Does cross-leg rocking cause pain? (Foot of affected side is placed on opposite knee and pressure is made on knee of affected side and opposite side of pelvis.)

(*e*) Does muscle spasm occur in the lumbar muscles, when these tests are made, in a manner consistent with the complaints of pain?

(*E*) RECTAL EXAMINATION. (Is the prostate normal or irregular and tender? Is pus obtained on massage? Is the coccyx normal?)

11. *x*-RAY EXAMINATION. (When indicated.)

12. THERAPEUTIC TESTS.

Does criss-cross strapping of the lower ribs to the hips supporting the lumbosacral ligaments give relief?

Is relief given by transverse strapping which supports and compresses sacro-iliac joints?

13. DIAGNOSIS:

(*a*) Conditions due to injury. Contusion of the back. Lumbosacral strain. Lumbar strain. Fracture of transverse processes of lumbar vertebra. Compression fracture of vertebral body. Fracture of vertebral spine. Fracture of vertebral lamina. Dislocation of vertebra. Spondylolisthesis. Fracture of sacrum. Fracture or dislocation of coccyx. Fracture of ilium involving sacro-iliac joint. Dislocation of sacro-iliac joint. Sacro-iliac sprain, etc.

(*b*) Conditions due to disease. Arthritis. Hypertrophic arthritis. Posture. Focal infection. Acute or chronic prostatitis. Fibrositis. Seminal vesiculitis. Flat foot. Tuberculosis of spine. Charcot joints of spine. Metastatic carcinoma of spine. Sarcoma of spine. Carcinoma of prostate. Carcinoma of rectum. Gastro-intestinal toxemia. Amebic infection of colon. Arthritis of sacro-iliac joint, etc.

(*c*) Congenital anomalies. Abnormalities of lumbosacral region. Spina bifida occulta. Congenital non-fusion of transverse processes of lumbar vertebra. Sacralization of transverse process of fifth lumbar vertebra, etc.

14. PROGNOSIS.

Signed............................M. D.

Address..................................

Sprains of the back are overstretching of the intervertebral ligaments and of the back muscles. They are caused by being thrown from horses, diving, football injuries, etc. It will be found that the patient accomplishes with difficulty certain motions that puts this portion on a strain. The portions of the strained muscle or the parts involved will be sensitive to pressure. All sprains of the back which do not clear up in a day or two of conservative treatment should be subjected to *x*-ray examination for the possible presence of a compression fracture of the vertebræ, or the fracture of a transverse fracture of a vertebra. The treatment consists of rest, heat, and gentle massage. In mild cases which may be considered ambulatory, and in severe cases as well, strapping of the back with adhesive plaster will be of benefit. This is done by having the patient strip to the waist and seat himself upon the table. The back will then be arched in extreme lordosis and a 3-inch wide strip of adhesive plaster will be applied immediately over the spine and extending from the coccyx to the seventh cervical vertebra. Alternate diagonal overlapping of supplementary strips of adhesive will then be applied (Fig. 117).

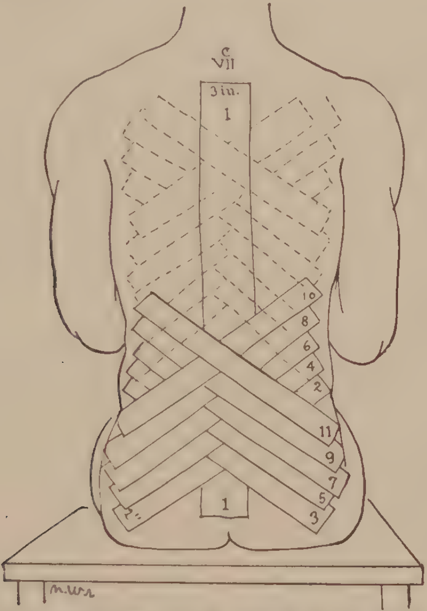

Fig. 117.—Method of applying adhesive in strains of the back. The patient sits in increased lordosis while the adhesive is applied.

Another, and perhaps a better, method is to have the patient lie prone upon the table with pillows under his chest and legs so as to produce the lordosis position and yet have the patient comfortable during the strapping (Fig. 118).

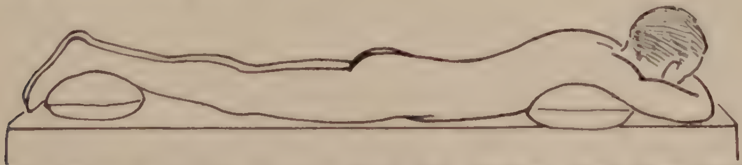

Fig. 118.—Prone position for strapping back with adhesive. Note pillow under the chest to increase lordosis.

Steindler[1] has made an interesting anatomical and clinical study of *low back pain*.[2] This writer believes that the large majority of the cases of low back pain due to mechanical causes are primary ligament strains with demonstrable rupture of the ligament, accompanied by extravasation of blood and subsequent scar formation. The sacro-iliac strains involve the sacro-iliac and capsular ligaments, while sacrolumbar strains involve the ligaments entering the lumbosacral articulation. The author studied 213 cases of low back sprain and compared the findings with those of studies on the cadaver. The following conclusions are drawn:

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[1] Steindler, A.: Jour. Iowa State Med. Soc., 15, 473, 1925.

[2] See also article by Cochrane, W. A.: Brit. Med. Jour., 3537, 696, October 20, 1928.

1. Flexion increases the strain and stress in the posterior sacro-iliac ligaments, the erector spinæ muscles, and their aponeuroses.
2. Extension increases strain at the sacrolumbar juncture, causing tension on the anterior longitudinal ligaments and the lateral ligaments between the ilia and the transverse processes of the fifth lumbar vertebra.
3. In lateral bending the roots of the lumbosacral plexus are relaxed on the concave side and tensed on the convex side.
4. Increased lordosis produces tension of the sympathetic plexus and ganglia.

Steindler studied 213 cases and classified them as follows:

1. Traumatic:	
(a) Sacro-iliac	55
(b) Lumbosacral	35
(c) Combined	8
2. Occupational:	
(a) Sacro-iliac	17
(b) Lumbosacral	9
(c) Combined	3
3. Postural:	
(a) Sacro-iliac	18
(b) Lumbosacral	26
4. Unclassified:	
(a) Sacro-iliac	34
(b) Lumbosacral	8

This author feels that sacro-iliac and sacrolumbar sprains are distinct injuries to the ligamentous apparatus in these regions. Neither position nor radiation are pathognomonic of either sacro-iliac or sacrolumbar strain, but both are of definite diagnostic importance. Backs showing anatomical variations are inherently weak and are susceptible to ligamentous strains. Lux[1] divides the pathologic changes of the sacro-iliac joint, according to their etiology, into traumatic and those of the acute and chronic arthritic sacro-iliac diseases. In the traumatic cases there is a history of violent pain in the region of the sacro-iliac joint when rapidly bending forward, or turning the trunk. The

[1] Lux, A.: Wien. klin. Wchnschr., 40, 88, January 20, 1927.

Gaenslen test is of value in making the diagnosis of sacro-iliac strain or disease. The patient lies supine at the edge of the examining table. The knee of the extremity which is toward the center of the table is drawn up to the chest as far as possible and firmly held there by the patient who clasps his hands over it. The surgeon then brings the other extremity down over the edge of the table. If there be marked sacro-iliac strain or disease on either side, the patient will experience a sharp pain in the region of the affected sacro-iliac joint. In the milder cases the pain is generally felt only when the corresponding extremity is extended. This pain is accentuated as the extremity is gently forced downward (Fig. 119). The treatment includes massage, diathermy, manipulation, and rest in bed with the patient lying on his back on a hard mattress. Immobilization in a plaster cast will occasionally be necessary. The symptoms of the acute and chronic inflammatory sacro-iliac diseases are more or less the same as those of the traumatic type although in the former the pain does not start so violently and is seldom referred by the patient to the region of the synchondrosis. Most of these patients complain of backache, lumbago, and often of pains of the leg of the same side. Tenderness of the joint on pressure is unusual. x-Ray examinations are of little value. The treatment includes external heat, diathermy, massage, exercises, and supporting corsets or belts. In all cases of chronic back pain search should be made for a focus of infection and if this be found, it should be corrected.

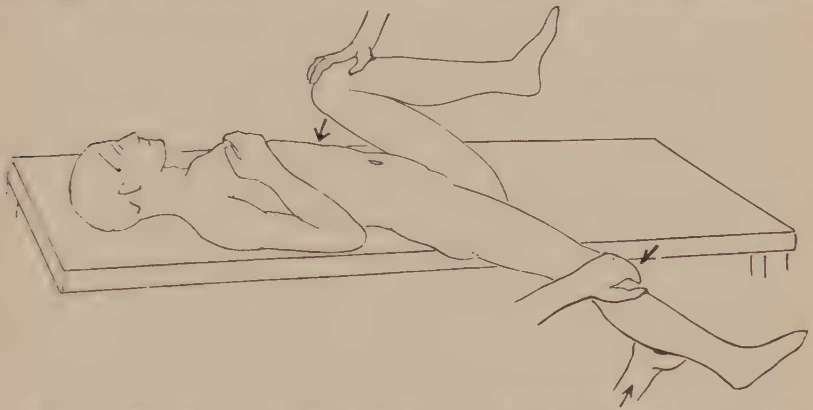

Fig. 119.—The Gaenslen test for sacro-iliac strain or disease. The flexed leg is held firmly by an assistant or by the patient himself. The opposite extremity is extended backward over the edge of the table. In the milder cases pain is felt only if the affected sacro-iliac is on the same side as the extended leg. In severe cases the pain will be felt in the sacro-iliac if either leg be extended.

Sciatica.—Putti[1] describes sciatica as a neuralgia caused by pathological conditions of the intervertebral foramina and articulations. He states that sciatic pain is symptomatic of vertebral arthritis except in those rare cases in which it is a symptom of a neuritis of specific nature. According to this author, sciatica is to be considered merely a symptom and he characterizes as meaningless the term "essential sciatica." The chief clinical manifestations of sciatica are pain and rigidity of the lumbar spine. Jones and Lovett[2] believe that "primary sciatica" is very rare. Feiling[3] differentiates between symptomatic sciatica (secondary to some gross pressure lesion) and a primary or essential sciatica. This author says that the treatment in the "peripheral" sciaticas or neuritis type consists of rest, immobilization, heat (by diathermy if possible), and saline injections into the trunk. In "central" sciaticas or neuralgias temporary relief is obtained by an epidural injection of normal saline or 10 to 20 c.c. of a 40 per cent. solution of antipyrine into the sacrococcygeal foramen where it can come into immediate contact with the nerve-roots. Hertzler[4] defines sciatica as a painful affection of the sciatic nerve due to conditions within the nerve itself, produced by causes unknown or by irritating lesions adjacent to the nerve, and persisting after the subsidence of those conditions. Pain in the sciatic nerve, according to this author, which is the result of some demonstrable organic disease should not be classified as sciatica. Hertzler injects the nerve where it crosses the neck of the femur with 1 ounce of a 1 per cent. solution of quinine urea hydrochloride, with excellent results.

4. **Fractures of the Trunk.**—*The Spine.*—There are many types of fractures involving the spine which may properly be considered as belonging to minor surgery. The majority of fractures of the spine without cord symptoms are minor surgical.

Compression fractures (*crushing fractures*) of the bodies of the vertebræ without cord symptoms are of very common occurrence and formerly were often overlooked in the absence of proper *x*-ray examination. According to Osgood,[5] compression fractures constitute 40 per cent. of all fractures of the spine. In most of the cases the body of only one vertebra is involved. This writer says that in 70 to 80 per cent. of the cases the vertebra involved is the eleventh or twelfth thoracic or the first or second lumbar vertebra. In from 50 to 60 per cent. it is the twelfth thoracic or the first lumbar vertebra. Any violent force which causes a sudden forcible hyperflexion of the spine may cause a compression fracture of the body of the vertebra. Falls from a height in a sitting position so as to strike on the buttocks, or falls from a horse which cause the patient to strike on his head and forcibly flex the spine, or accidents in coasting where children on sleds will strike head-on into a tree are particularly prone to cause these fractures.

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[1] Putti, V.: Lancet, 1927, 213, 52.

[2] Jones, Sir R., and Lovett, R. W.: Orthopedic Surgery, William Wood & Co., 1923, p. 272.

[3] Feiling, A.: Brit. Med. Jour., 1928, 1, 386.

[4] Hertzler, A. E.: Amer. Jour. Surg., 1926, n. s., 1, 200.

[5] Osgood, R. B.: Jour. Amer. Med. Assoc., 89, 1563, 1927.

Fig. 120.—Neglected compression fracture of the twelfth dorsal vertebra. The injury was not recognized for a year and a half after the injury.

In neglected cases of compression fractures of the bodies of the vertebræ a traumatic spondylitis, or Kümmell's disease, may occur. This may come as late as months or years after the injury and is accompanied by increasing kyphosis, pain localized in the injured area and radiating down the extremities. The lateral x-ray view shows a triangular shaped body the apex of which is pointed anteriorly (Fig. 120). According to Cardis, Walker, and Oliver,[1] there are two chief theories as to the basic pathology of Kümmell's disease. According to one, it is a collapse of the vertebral bodies following injury to the small vessels, with focal hemorrhages and thromboses. According to the other, it is a trophic disturbance of the vertebral bodies due to injury to the nerves and the cord. Osgood cautions the surgeon to look for a tarsal fracture in cases of fractures sustained by falls.

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[1] Cardis, J., Walker, F. G., and Oliver, R. H.: Brit. Jour. Surg., 15, 616, 1928.

The diagnosis of compression fracture of the spine is based upon the history of injury of the proper type, upon the presence of localized pain, and upon the *x*-ray examination, particularly the lateral view which is absolutely essential. Patients with compression fractures of the vertebræ should be treated for some six or eight weeks in lordosis, lying on a Bradford frame in the supine position with padding so built up under the small of the back as to cause the proper amount of dorsal arching of the back. If perceptible kyphosis be present, the lordosis will be gradually increased. This may be done by gradually increasing the supporting pillows under the affected part or by the use of pressure pads. Boorstein[1] placed these pressure pads "on either side of the spinous processes opposite the prominent vertebræ, usually the vertebra below the break. Day by day the padding can be raised without discomfort until the desired correction is reached." The best method is probably the placing under the back of a properly fitted canvas hammock or the back half of a corset. The hammock or corset is transfixed at both ends with a strong stick or metal rod to maintain its spread out position. To both ends of each rod, cords are carried upward to a wooden or metal spreader at least 1 yard wide. The spreader is suspended from a Balkan frame by an attachment which includes a turnbuckle. The adjustment of the turnbuckle will determine the exact amount of lordosis. In many cases the patient does not do well on a Bradford frame and it is necessary to apply a plaster jacket or cast. The plaster cast is applied by means of an Abbott frame (Fig. 120a). The patient is suspended on a flat canvas hammock, lying face downward. The hammock is so adjusted as to make the desired degree of lordosis. After the skin has been well powdered a longitudinal piece of bandage is placed next to the skin. This may be drawn to and fro as a "scratcher" after the cast has been completed. The body is now enveloped in a shirt of appropriately sized stockinet, which may be cut and sewed so as to fashion shoulder straps. Be sure to leave enough stockinet to turn back into cast. An extra layer of stockinet may be placed about the body so as to include the canvas strip upon which the patient is lying. By this procedure the canvas strip may more readily be removed after the cast is completed. The bony prominences of the spinous processes, the crests of the ilia, and the spines of the scapula are protected by ample sized felt pads whose edges have been beveled. Some surgeons prefer to sew these pads to the stockinet in their proper situation and others place them on top of the double layer of sheet wadding which comes between the stockinet and the plaster of Paris. If the pads have been sewed to the stockinet, the double or triple layer of sheet wadding is placed over them. The cast is then constructed by snugly winding on 6-inch plaster-of-Paris bandages, taking care that the bandages are constantly rubbed as they are applied. When the cast is dry the edges will be trimmed so as to permit action of the legs and arms and permit defecation. After the cast has dried the stockinet edges are turned over and fastened down to the cast by means of adhesive plaster. This is important as a preventive against the getting inside of the cast of plaster crumbs. After the cast has been applied the patient should not be permitted to sit up because of the weight bearing on the affected surfaces. At the end

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[1] Boorstein, S. W.: Amer. Jour. Surg., n. s., 3, 119, August, 1927.

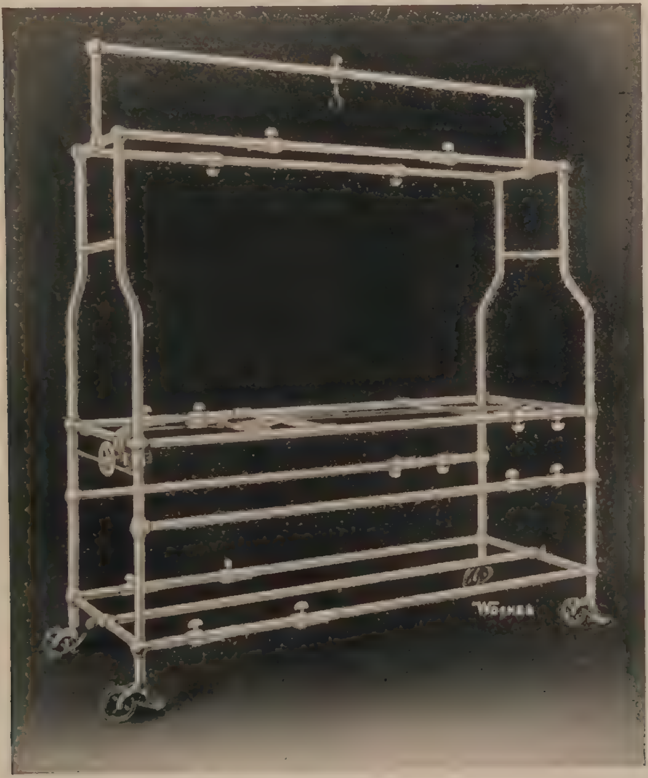

Fig. 120a.—Abbott frame.

of six weeks the cast will be removed and a Taylor spine brace (Fig. 121) holding the spine in lordosis will be applied and the patient allowed to walk about in increasing amounts. At the end of six months it generally may be removed. Further roentgenological examinations should be made at six-month intervals for several years. Physiotherapy will be useful in the last weeks of the treatment. Osgood finds a full return to function in these cases in four to six months.

Fractures of the Transverse Processes of the Vertebræ.—Previous to the general use of the *x*-ray, cases in which there was a fracture of a transverse process of a lumbar vertebra were not uncommonly treated as "sprained backs." We now know that such fractures are not rare. They are perhaps more frequent as complications of other injuries and seldom occur alone. In the mining district of Bochum, Magnus[1] found 99 isolated fractures of the transverse process of the vertebræ. The first lumbar was involved 44 times; the second 16 times; the third 18 times; the fourth 11 times; the fifth twice. These fractures are caused most commonly by direct violence. They may also be caused by the forcible contraction of the psoas and quadratus lumborum and longissimus dorsi muscles as when lifting heavy weights when in the flexed forward position or in cranking a motor (Speed). The first symptom is

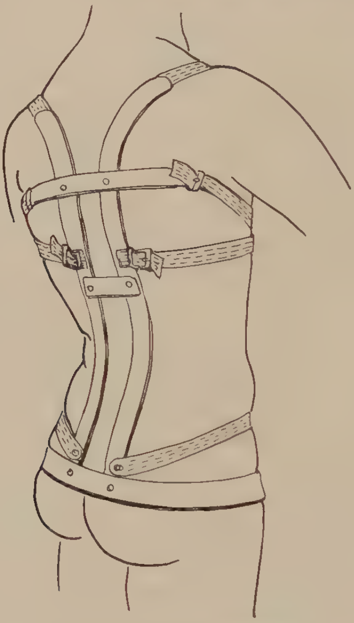

Fig. 121.—Taylor spine brace.

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[1] Magnus: 52 Tag. d. Deutsch. Ges. f. Chir., Berlin, 1928.

generally a very acute pain with some localized tenderness. Sitting up or raising the leg when lying on the back is painful. The diagnosis is made certain by x-ray. In interpreting the x-ray one should remember that the transverse process of the first lumbar vertebra often shows a joint at its distal end (lumbar rib). Speed[1] calls attention to the early symptom of abdominal pain caused by pressure of the fragments or of a hematoma on the nerve-trunks. The treatment of isolated fractures of the transverse process of the lumbar vertebra is rest in bed from sixteen to twenty-five days, accompanied by heat and massage. In some cases the back may be strapped with adhesive plaster, but immobilization in plaster of Paris is condemned by most surgeons. The patient should be careful for two months, but should be completely cured in six months. It is extremely important not to let the patient overestimate the seriousness of his case. If he feels that he has a "broken back," complete recovery will be delayed if not indefinitely postponed. If the fragment is widely separated and non-union and pain continue, the operative removal of the detached fragment should be considered.

Fractures of the Coccyx; Dislocation of the Coccyx.—Heavy falls upon sharp edges, kicks, or difficult parturition may bring about injury to the coccyx. This injury may be a fracture of the coccyx itself, a rupture of the ligaments which attach the coccyx to the sacrum, or dislocation of the coccyx. In the late cases where the fracture has healed in an abnormal position there may be severe pain upon sitting, pain upon defecation, and persistent neuralgic pains in the thighs and legs. These symptoms are generally included under the term *coccygodynia.* In all cases of pain and tenderness in the coccygeal region where an injury of the coccyx is suspected, it will be advisable to have an x-ray examination in two planes, the lateral being the more important. Moreover, in all cases where injury to the coccyx is suspected an examination should be made with the gloved finger in the rectum, and between it and the palpating external finger the presence or absence of crepitation, abnormal mobility, or displacement will be elicited. Extensive ecchymosis of the gluteal regions and upper thighs is not uncommon.

In recent cases the *treatment* will consist of replacement of the displaced fragment. This procedure is carried out by having one finger in the rectum and the opposite hand on the outside. A general anesthesia will often be necessary. After reduction of the deformity has been accomplished rest in bed for a period of two to three weeks is advisable. In cases of dislocation, where the dislocation recurs several times after displacement and is accompanied by pain, and in cases of fracture where

[1] Speed, Kellogg: Fractures and Dislocations, 2d ed., Lea & Febiger, 1928, p. 180.

there is continued pain and discomfort even after union has occurred or where malunion has occurred, the operative removal of the coccyx is indicated. The operation is carried out through a posterior midline incision, and the coccyx is dissected out and removed from the sacrococcygeal junction. Speed[1] emphasizes the importance of rigid asepsis and adds that the "relief is due to the severance of the coccygeal nerves or their release from pressure by the misplaced bone."

Minor Fractures of the Pelvis.—The pelvis is injured by crushing forces supplied in that region, particularly when patients are squeezed between two cars or when a vehicle passes over the pelvis. In all cases where an injury to the pelvis is suspected the urine should be examined for the presence of blood, which would indicate a laceration of the bladder. If necessary, catheterization should be resorted to to obtain a specimen. Failure to recover urine after catheterization indicates rupture of the bladder and major surgical treatment is indicated. A rectal examination should be carefully made in order to search for lacerations of the rectal mucosa. The abdomen itself should carefully be examined for the existence of intraperitoneal injury. *x*-Ray examination in two planes is a *sine qua non*. A stereoscopic examination may be of value. A great many fractures of the pelvis may be classified as minor fractures. In all cases where there is no injury to the bladder, rectum, or peritoneum, or in which there is no mobility of the fragments,

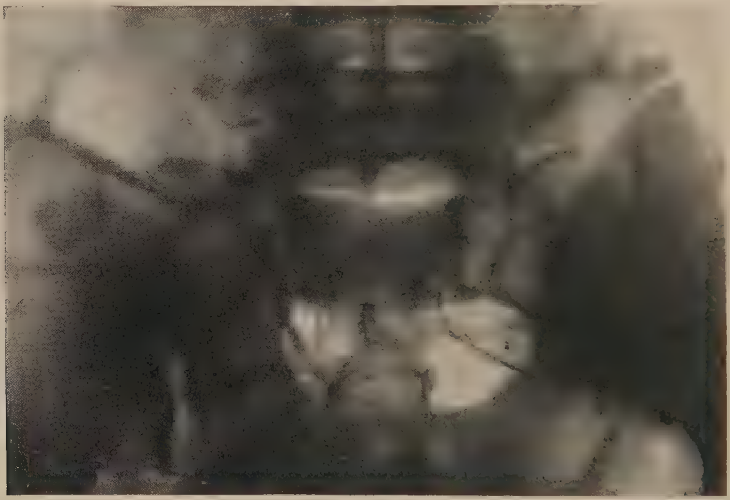

Fig. 122.—Fracture involving sacro-iliac joint and transverse process of fifth lumbar vertebra.

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[1] Speed, Kellogg: Fractures and Dislocations, 2d ed., Lea & Febiger, 1928, p. 582.

the injury may be regarded as a minor fracture. Minor fractures of the pelvis, conversely, may be defined as impacted fractures of the rami of the pubis, as the linear fractures of the ilium, and the linear fractures of the sacrum, *without* visceral injury or mobility of the fragment (Fig. 122).

The *treatment* of minor fractures of the pelvis is rest in bed for an adequate length of time. Certain very minor injuries may be permitted to walk in from two to three weeks. Where the fissures are more extensive and are multiple, a rest period of four to six weeks will be required. The patient is not permitted to sit up in bed during this time because the pressure upon the tuberosities of the ischii will cause a strain at the site of the fractures. Before permitting the patient to walk, it will be well in all cases to equip him with a Goldthwaite belt or a strong supporting girdle which exerts compression on the great trochanters of the femur and upon the iliac crests. These patients are apt for a long time to complain of pain in the back or in the other regions of the pelvis. This will be treated by external heat, by diathermy, and by massage. The prognosis in cases of minor fractures of the pelvis generally is excellent.

Fractures of the Clavicle.—With but few exceptions fractures of the clavicle belong to minor surgery. The exceptions are severe compound fractures of the clavicle, severe comminuted fractures of the clavicle, and the very rare cases of non-union which require an open operation. Some 5 to 10 per cent. of all fractures occur in the clavicle. In 10,702 cases of fracture at the Cook County Hospital, Speed[1] found 538 clavicular fractures. Hey Groves[2] states that there is probably no bone the fractures of which are so infrequently accompanied by serious complications or so seldom require operative treatment. The clavicle is the earliest bone in the body to ossify and this may account for the frequency of clavicle fractures in youth. Fractures of the clavicle almost invariably are incurred by falls or blows upon the shoulder, so that the force is directed medially toward the sternum. Some 6 per cent. of fractures of the clavicle are caused by direct violence. Many patients are immediately conscious that they have broken their collar bones by the sensation of subjective crepitus and by the abnormal deformity in the clavicular region, due to the tendency of the unsupported shoulder to drop downward, with the resultant prominence of the fragment ends at the fracture. In most cases simple palpation of the clavicle will establish the diagnosis but an *x*-ray must under no

[1] Speed, Kellogg: Fractures and Dislocations, 2d ed., Lea & Febiger, 1928, p. 218.

[2] Groves, Hey: Lancet, April 16, 1927.

circumstances be omitted because it will often reveal a comminution or a more marked displacement than was suspected (Figs. 123–128).

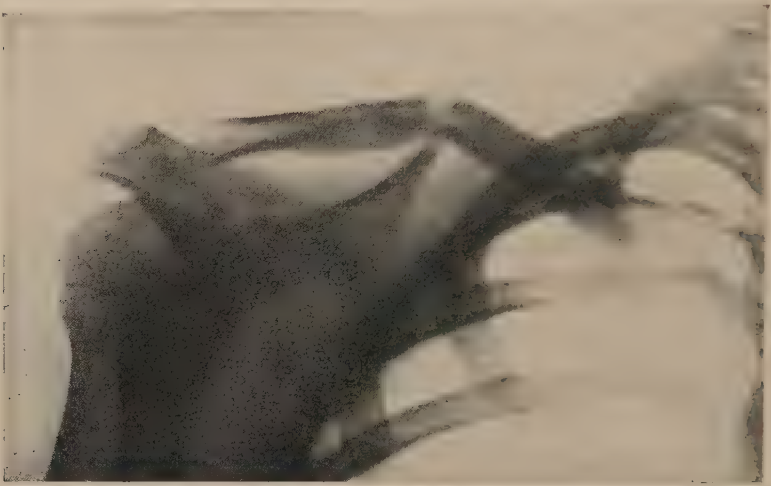

Fig. 123.—Greenstick fracture of the clavicle.

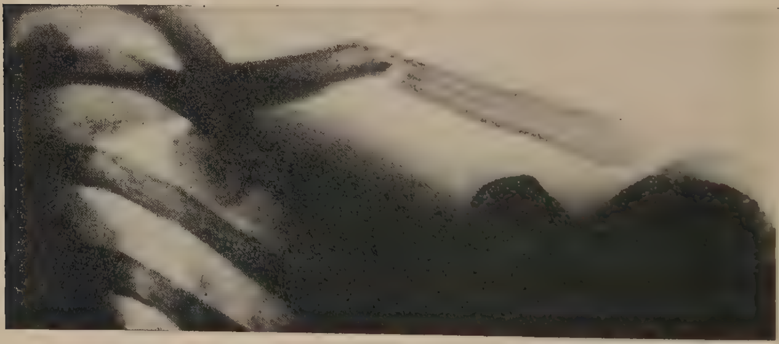

Fig. 124.—Complete fracture of the clavicle; good position.

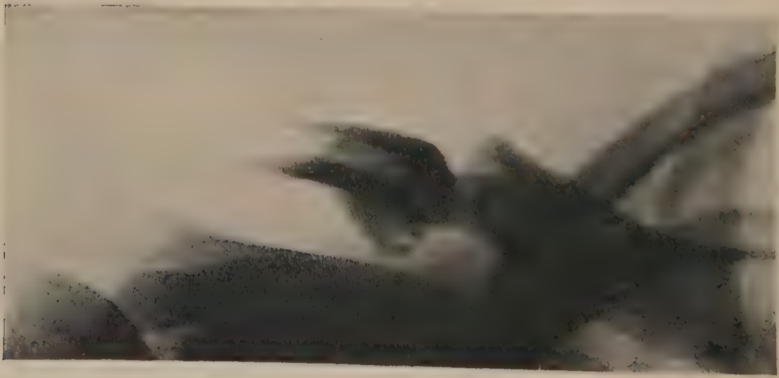

Fig. 125.—Comminuted fracture of the clavicle.

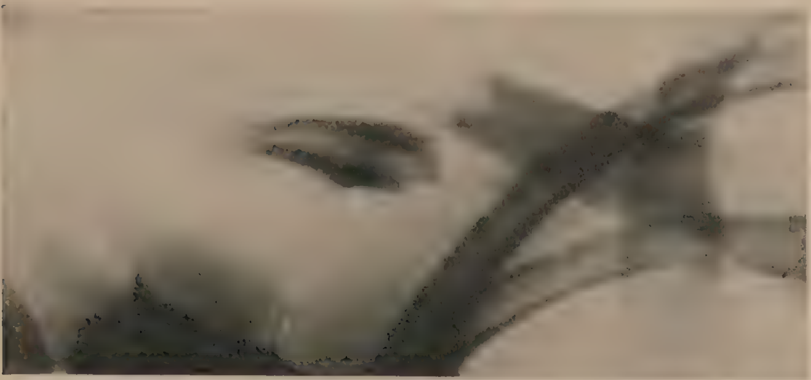

Fig. 126.—Fracture of the clavicle with displacement of the fragments.

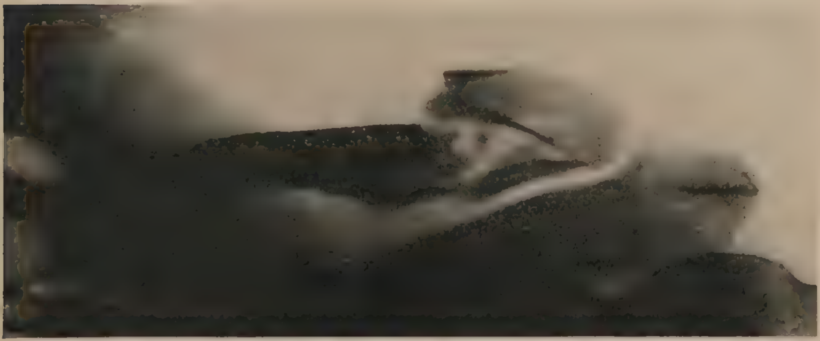

Fig. 127.—Comminuted fracture of the distal end of the clavicle.

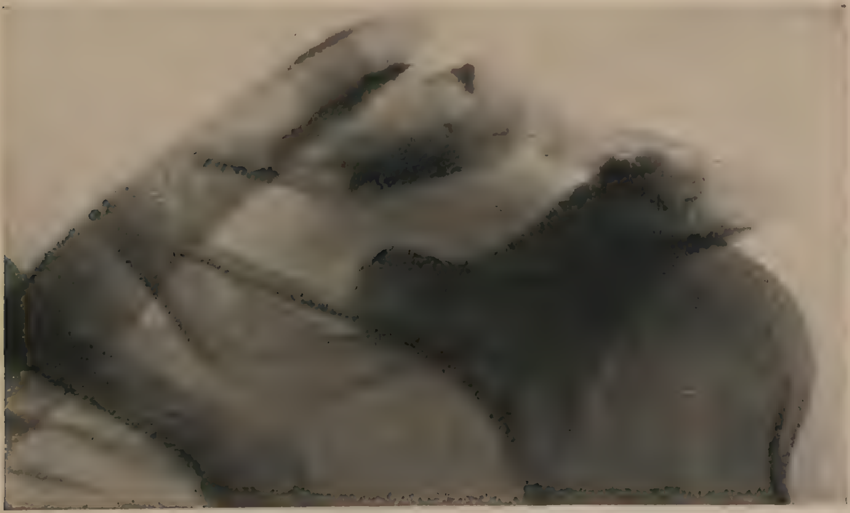

Fig. 128.—Severe comminuted fracture of the clavicle.

In young infants fractures of the clavicle are very common and frequently are overlooked. The baby has had a fall which has not been observed by any one. The existence of the fall even may be unknown, but the child will be found to be whimpering and showing evidences of pain and will exhibit difficulty *in using the arm* on the affected side. The parent's attention will be directed toward the arm and the existence of a collar-bone injury will most often not be suspected by them and, sad to say, by the physician himself. Patient and careful palpation of the shoulder will generally elicit a tender spot and often deformity along the clavicle. Movement of the arm is painful. x-Ray examination, of course, should never be withheld. Fractures of the clavicle in elderly persons are frequently accompanied by considerable shock and a great deal of pain. In these cases the first-aid treatment should be directed toward pain and shock, and the position of the clavicle should be neglected until these conditions are alleviated.

Before the application of any type of ambulatory dressing an attempt should be made to reduce the fracture. This is generally best accomplished by having the patient sit upright, and with the patient's muscular co-operation drawing both of the shoulders backward. The surgeon's knee may be placed in the middle of the back to make counter-traction. Drawing the arm upward and outward with counter-traction on the side of the neck is occasionally useful (Speed).

The fundamental principle involved in the *treatment of fractures of the clavicle* is traction. In the absence of traction the pull of the pectoral and scapular muscles and the weight of the arm will drag the shoulder mesially and will cause an overriding, or an upward or downward deformity of the fragments. At least ninety methods of fixation of the clavicle have been published. In 1921 von Mezo[1] collected eighty-five published methods of fixation of fractured clavicles. The writer knows of at least five other new methods published since that time.

The surgeon will probably be able to assure the patient of a better anatomical result with the recumbent treatment, but the large majority of individuals will choose the ambulatory treatment in preference, especially when they can be told that the functional result will be excellent. The ambulatory treatment will be considered first. In the ambulatory treatment, by far the best method of obtaining traction and the consequent proper position of the fragments is the employment of such an apparatus as will hold *both* shoulders *backward and upward*. Various braces have been devised for this purpose. The clavicular cross splint, which is made of aluminum, is well padded with felt, has a vertical piece extending downward to the waist, has well-padded, adjustable straps which pass under both axillæ, and has a belt, is the most serviceable for adults[1] (Fig. 129).[2] In infants and very young children an all-leather brace which fits under both shoulders and straps across the scapulæ is ideal (Fig. 130).[3] Both of these types of clavicular splints should be put on at first with but slight traction, because the patient may ill adapt himself to the pressure under the axilla. After he has worn it loosely for twenty-four hours he will unconsciously acquire the habit of retracting his shoulders to pull away from his braces. The straps will then be tightened, so that the

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[1] von Mezo, Bela: Zentralbl. f. Chir., 48, 886, June 26, 1921; 48, 968, July 9, 1921, quoted by Eliason.

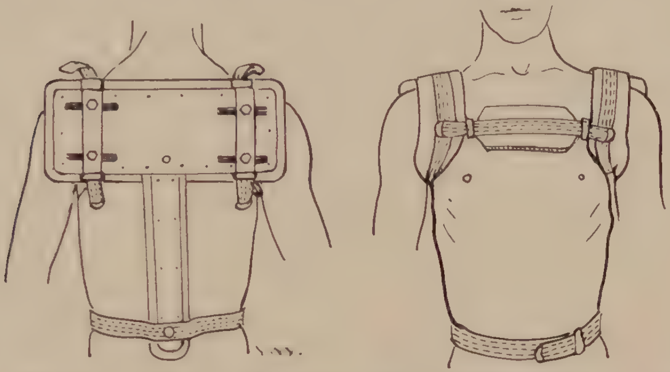

Fig. 129.—Aluminum clavicular cross splint. (Zimmer Manufacturing Co., Warsaw, Indiana.)

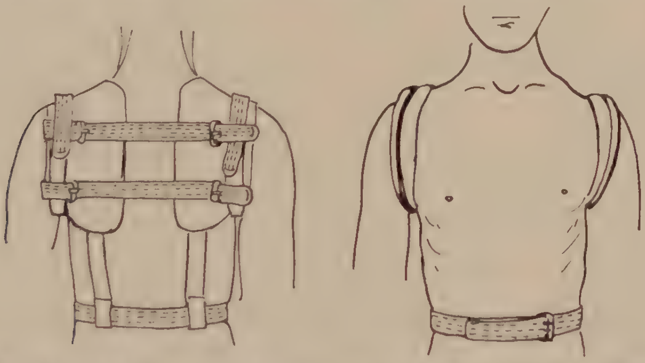

Fig. 130.—Adjustable clavicular brace. (DuPuy Splint Co., Warsaw, Indiana.)

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[1] Zimmer Manufacturing Co., Warsaw, Indiana.

[2] A very serviceable adjustable clavicular cross splint is made by the DuPuy Manufacturing Company of Warsaw, Indiana.

[3] DuPuy's splint made by the DuPuy Splint Co., Warsaw, Indiana.

shoulders will be held as far back as possible. The patient will be cautioned to watch for any circulatory disturbance of the arm or for any numbness or tingling pain which might be due to unusual pressure upon the nerves. Inasmuch as the pull of the braces is directed chiefly backward and not upward, a traumatic paralysis (Saturday night paralysis), from pressure upon the brachial plexus, is extremely unlikely. Patients who chafe at the restraint of the braces will more gradually accustom themselves to it if they are advised to lie on their backs as much as possible for the first few days and to relieve the pressure of the braces by holding their arms akimbo. Richards[1] used the Landry posterior splint in fifty patients and in only 1 case did the patient complain. It is surprising how well these clavicular cross braces and splints are tolerated, and in a very few days the patient will be in a far more comfortable and useful condition than with the old-fashioned Velpeau-Sayre dressings and casts which, moreover, cause limitation of the shoulder-joints after removal. Both arms will be free and may be actively used. The patient may wear his clothing, both arms being allowed to go into the sleeves, and encouraged to go about his daily

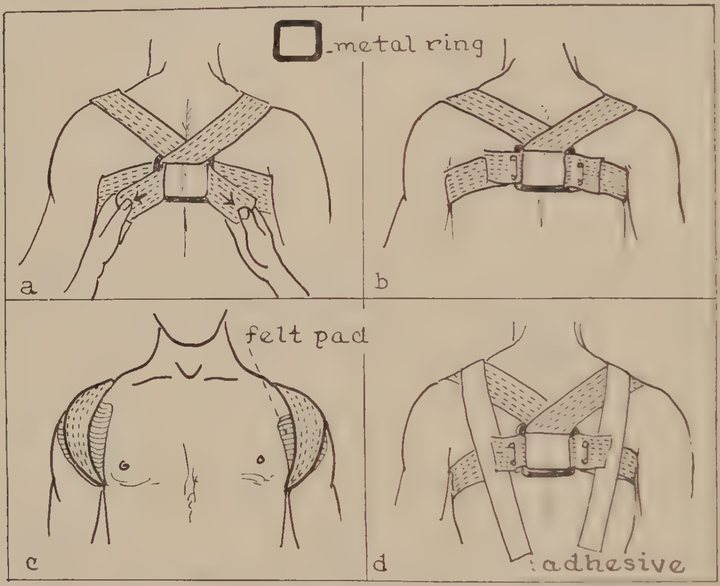

Fig. 131.—Posterior brace for fractures of the clavicle. The brace consists of a metal square and cotton webbing. (Rynkiewicz, S. H., Jour. Amer. Med. Assoc., December 12, 1925.)

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[1] Richards, T. K.: Jour. Amer. Med. Assoc., 79, 1839, November 25, 1922, quoted by Eliason.

business. In about forty-eight hours young children will be playing as vigorously as they did before the injury, in fact, so zealously that they will have to be restrained. Rynkiewicz[1] has devised a very simple and efficient posterior brace for fractures of the clavicle. The appliance consists of cotton webbing and a wire square and is readily adjustable (Fig. 131). For fractures of the proximal and middle thirds of the clavicle, Thomson[2] uses a figure-of-8 plaster cast which is applied over a sheet wadding bandage while the arms are held abducted upward and backward. The cast embraces the chest and can be cut out about the neck and arms without weakening. Funston[3] has devised a padded splint which exerts backward pressure upon the heads of the humeri (Figs. 132, 133).

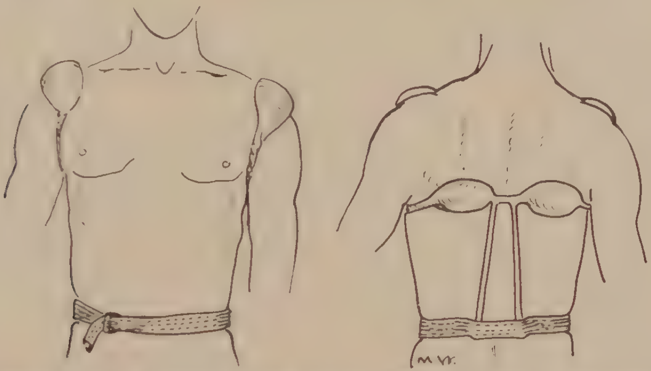

Fig. 132.—Splint for fractures of the clavicle. The splint exerts a backward pressure upon the heads of the humeri. (Funston, R. V., Jour. Amer. Med. Assoc., September 15, 1928.)

In the absence of clavicular cross splint, either commercial or homemade, the most serviceable dressing is that proposed by Sayre. It is only after thoughtful consideration that the writer describes the use of the Sayre dressing. He hesitates because his distinguished friend and colleague, Magnuson, has said, "One thing that the men who are interested in fractures can do for the benefit of humanity is to eliminate the descriptions of the Sayre dressings from all text-books. It is a good mechanical scheme, but from the standpoint of the patient it is an extremely unworkable proposition." However, many satisfactory results have been obtained by the use of the Sayre dressing and it seems wise to the writer to include a description of it and to concede its use when a posterior splint or the recumbent position is not feasible. To be of service the Sayre dressing must be properly applied. For an adult a 4- to 6-inch wide band of adhesive plaster about 2 feet in length is prepared with a loop at one end, whose circumference is at least one-third more than the circumference of the affected arm. The inside of the loop is well padded with felt or cotton and is slipped over the arm (Fig. 134). The patient is then instructed to retract the shoulders as far as possible and this retraction is accentuated by the hands of an assistant who forcibly pulls the shoulders back, occasionally with the aid of his knee applied in the middle of the back. The elbow is then held close to the body and an inch or so posterior to the midaxillary line. The adhesive band is then firmly drawn backward and toward the opposite side and fixed to the chest wall as far as the anterior side of the chest on the opposite side (Fig. 135). The elbow is now pulled forward in front of the midaxillary line and with the adhesive loop acting as a fulcrum, the shoulder on the injured side is forced still further backward, thus exerting traction upon the injured clavicle. The forward position of the elbow and elevation of shoulder are maintained either by an adhesive strap running from it along the forearm

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[1] Rynkiewicz, S. H.: Jour. Amer. Med. Assoc., December 12, 1925.

[2] Thomson, J. E. M.: Jour. Amer. Med. Assoc., 86, 1517, 1926.

[3] Funston, R. V.: Jour. Amer. Med. Assoc., September 15, 1928.

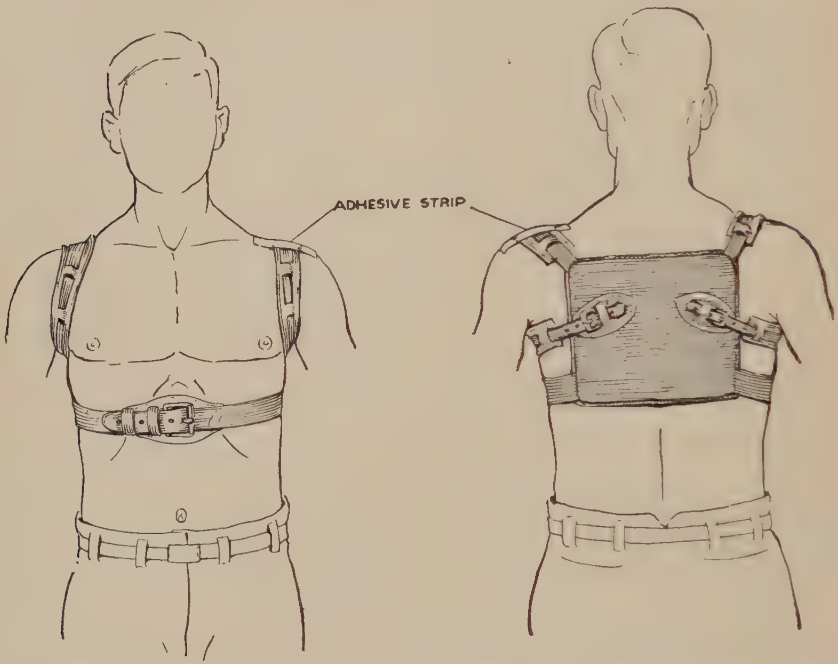

Fig. 133.—Valentine's splint for fractured clavicle. (From Forrester's "Imperative Traumatic Surgery," published by Paul B. Hoeber, Inc.)

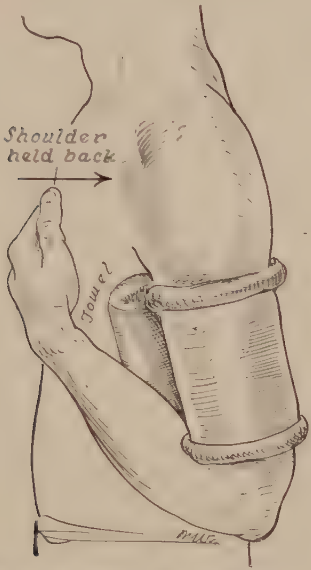
Shoulder held back
Towel

Fig. 134.—Sayre dressing for fracture of the clavicle. The shoulders are drawn well back. A powdered towel or cotton pad is placed in the axilla. The elbow is placed back of the midaxillary line.

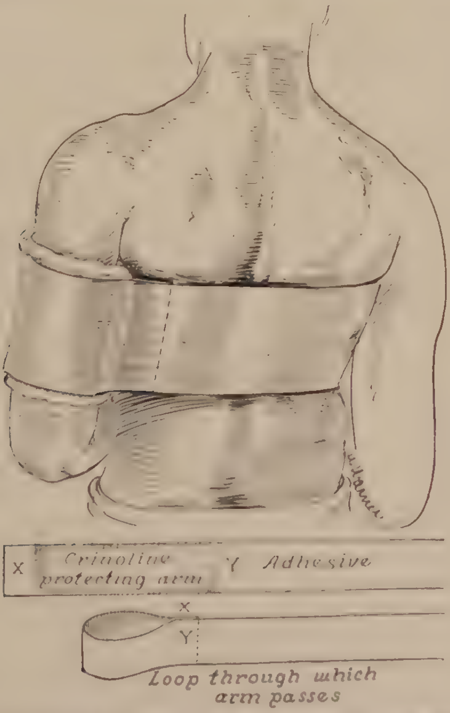
X
Crinoline protecting arm
Y
Adhesive
X
Y
Loop through which arm passes

Fig. 135.—Sayre dressing for fracture of the clavicle. The arm is passed through the padded loop of the adhesive, and the latter is made fast to the chest wall so that the arm is held snugly to the side with the elbow still posterior.

to the unaffected shoulder or by a properly applied Velpeau bandage (Figs. 136, 137). It is extremely important to have the loop in the adhesive band well padded and larger than the arm, as otherwise the circulation may be impeded. There should be no sharp edges in this

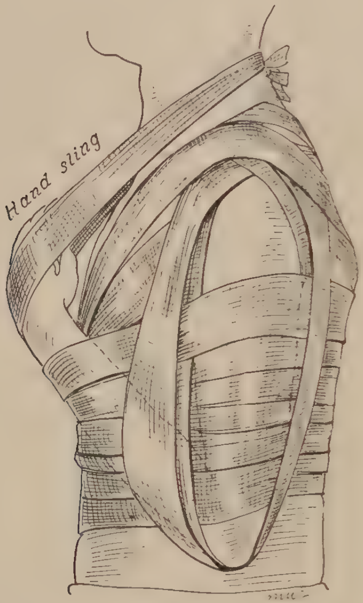

Fig. 136.—Sayre dressing for fracture of the clavicle. A Velpeau bandage (see Fig. 137) has been applied in such a manner as to bring the elbow forward to the midaxillary line. The adhesive loop acts as a fulcrum and the shoulder is still further retracted.

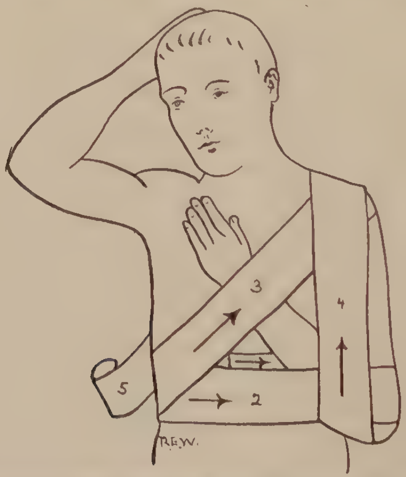

Fig. 137.—Diagram showing proper steps in making a Velpeau bandage. (After Scudder, C. L., Treatment of Fractures.)

loop cutting the skin. Such a dressing is worn from three to four weeks. It will be desirable to release the hand and forearm somewhat before this time and to begin motion at the elbow-joint. The Velpeau bandage is superior to the adhesive strap on the forearm because by its use freedom at the hand and wrist may be obtained, which is greatly appreciated by the patient. The skin under the Velpeau bandage should be abundantly and repeatedly powdered with borated talcum powder. For this purpose an insect powder blower is admirable. Powder may be blown to otherwise inaccessible portions of the skin.

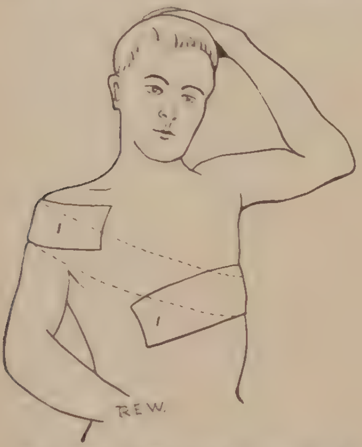

Fig. 138.—Adhesive dressing for fracture of clavicle. Application of adhesive strip 1. This pulls the shoulder back, aiding approximation of overlapped fragments. The hand of the uninvolved side should remain on top of the head throughout the whole period of the application of the dressing. (Conwell, H. E., Jour. Amer. Med. Assoc., March 17, 1928.)

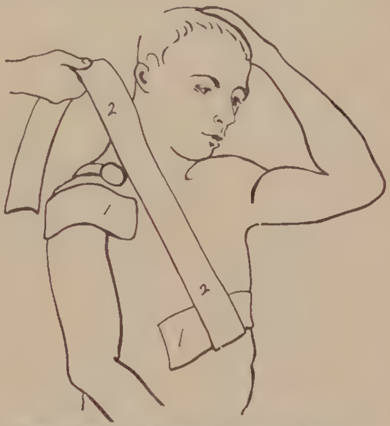

Fig. 139.—Adhesive dressing for fracture of clavicle. Felt pad and adhesive strip 2 being applied. This procedure prevents an exaggerated upward misplacement of the proximal fragment. (Conwell, H. E., Jour. Amer. Med. Assoc., March 17, 1928.)

Conwell[1] studied a series of 92 cases of fractures of the clavicle. The final position was good in 50 cases, fair in 37, and poor in 15. His functional results were excellent in 75 cases, fair in 12, and poor in 5. His treatment was either by a simple adhesive fixation dressing of his own invention (Figs. 138–144), or by traction with the arm in his right angle abduction splint and 90 degrees of external rotation at the shoulder-joint.

The plaster cast is now obsolete in the treatment of fractures of the clavicle. In elderly people the amount of exudate and callus thrown out at the site of the fracture may cause a great deal of pain and in some cases stiffness and swelling of the fingers and wrists. The best treatment for this unpleasant complication is heat, massage, and elastic traction to the fingers and wrists, and similar physiotherapy to the shoulder.

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[1] Conwell, H. Earle: Jour. Amer. Med. Assoc., 90, 838, March 17, 1928.

In infants and very young children the writer prefers the DuPuy splint (Fig. 130). If there be a greenstick fracture with upward bowing of the fragments, it is wise to administer a light general anesthesia and correct the deformity, taking care not to overcorrect it and bring about a complete fracture. In infants and young children Speed[1] recommends the following treatment: "The child's skin is carefully washed with alcohol, a simple desiccating or toilet powder is applied, and the arm is bound to the chest by a broad washed muslin band which is pinned snugly up the front. The forearm and hand are free and are supported by a light sling about the neck. The band is removed every other day for the cleansing and inspection of the skin of the chest and arm, and powder is reapplied." In greenstick fractures, if the callus is satisfactory in two weeks, the band may be exchanged for a sling.

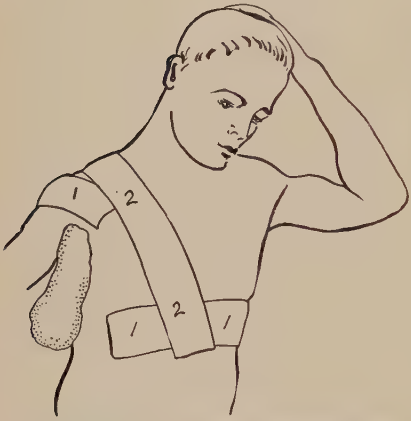

Fig. 140.—The cotton prevents coaptation of the skin surfaces and acts as a fulcrum to the arm and strip 4 in relieving any overlapping of the fragments. (Conwell, H. E., Jour. Amer. Med. Assoc., March 17, 1928.)

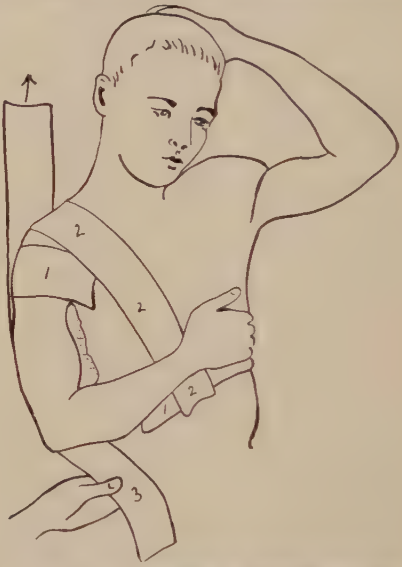

Fig. 141.—Adhesive dressing for fracture of clavicle. Adhesive strip 3 being applied. This raises the arm and shoulder, thereby aiding further approximation of the downward misplaced distal fragment. Cotton should always be applied underneath the elbow. (Conwell, H. E., Jour. Amer. Med. Assoc., March 17, 1928.)

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[1] Speed, Kellogg: Fractures and Dislocations, 2d ed., Lea & Febiger, 1928, p. 234.

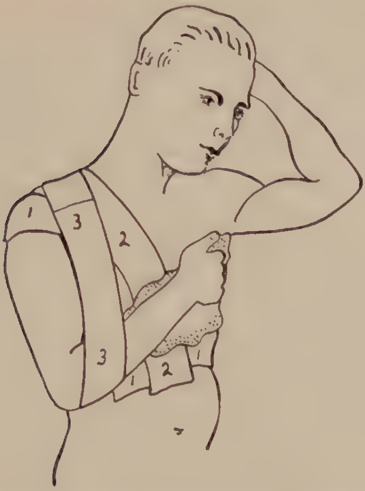

Fig. 142.—Adhesive dressing for fracture of the clavicle. Adhesive strip 3 applied. (Conwell, H. E., Jour. Amer. Med. Assoc. March 17, 1928.)

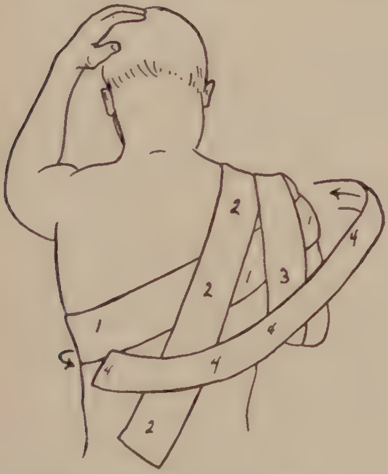

Fig. 143.—Adhesive dressing for fracture of the clavicle. Adhesive strip 1 crossing the back obliquely around to the front of the chest from the uninvolved side of the back and axilla. The termination of adhesive strip 2 and the commencement of adhesive strip 4 are shown. The latter crosses horizontally across the back, then across the lower third of the arm on the involved side, and then around in front across the forearm (see Fig. 144). The posterior application of strip 3 is also shown. (Conwell, H. E., Jour. Amer. Med. Assoc., March 17, 1928.)

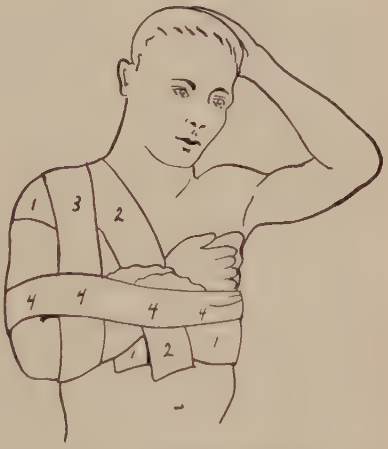

Fig. 144.—Adhesive dressing for fracture of the clavicle. The completed dressing, showing the elbow flexed with the forearm against the chest and adhesive strip 4 horizontally crossing the arm and forearm ending at the point where it commenced. Cotton should always be placed between the skin surface and the adhesive strips and the forearm. (Conwell, H. E., Jour. Amer. Med. Assoc., March 17, 1928.)

In women who ill support fixation appliances, or who insist upon an accurate anatomical result, the recumbent treatment may be tried. The recumbent treatment as popularized by Coutland[1] is described by Eliason.[2] The patient is placed "on his back on a firm flat mattress with the arm hanging over the side of the bed; a pillow is placed under the head but not under the injured shoulder. This position is held for an hour to an hour and a half, when the fracture will have become reduced. Then the second position is assumed by simply placing the forearm on a pillow on a bedside support, slightly lower than the elbow, but not supporting the elbow itself, rather leaving it so that gravity still acts. A sling for the wrist to the side of the bed may be used. This is maintained for seven days." Speed advises continuing the bed treatment for four weeks, in the latter half of which the arm may be placed in bed beside the body of the patient. The hanging position is extremely hard to endure and morphine will often be necessary for the pain. Mackenzie[3] treats his fractures of the clavicle in much the same way. The arm is allowed to hang straight down toward the floor for four hours. For the remainder of the treatment the patient is allowed to rest his elbow on a pillow on a chair beside the bed in an easy position, but with some slight drag on the shoulder. This author, who has used the method for years, claims that it gives immediate relief from pain and, in his hands, has never failed.

Whatever type of treatment is adopted in cases of fracture of the clavicle, it is well to remember the advice of Eliason, "It is the man behind the splint that counts."

It is very difficult to secure anatomical reposition of the fragments in fractures of the clavicle, but it is surprising how small the ultimate deformity will be with considerable amount of malposition. Even overriding of $\frac{1}{4}$ to $\frac{1}{2}$ inch will generally be attended by a perfect functional result. In all cases the patient should be informed that the process of healing is attended by the formation of callus and that the callus will manifest itself as a lump on his collar-bone at the site of the fracture; that this lump is a necessary and beneficial phase of repair of the clavicle and will subside almost completely in from six months to a year.

Minor Fractures of the Scapula.—All fractures of the scapula which are not compound and which do not have wide separation of the fragments may be considered as minor fractures. Linear fractures of the body of the scapula and of the spine require no other treatment than the abstaining from use of the arm which for comfort may be held in a sling, or if this is not sufficient to relieve pain, the arm may be bandaged to the body.

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[1] Coutland: Tr. Acad. Med., May, 1924.

[2] Eliason, E. L.: Jour. Amer. Med. Assoc., 91, 1976, December 22, 1928.

[3] Mackenzie, J. F.: Med. Jour. Australia, ii, 485, 1926.

Fractures of the acromion process are the commonest injuries to the scapula. They are classified by Speed[1] as follows:

1. Sprain fractures, caused by ligamentous or muscular tearing out of the bone surface.

(*a*) At the insertion of the coraco-acromial ligament caused by direct violence involving this ligament.

(*b*) At or about the acromioclavicular joint.

(*c*) On the upper surface of the acromion.

(*d*) At the top or outer surface of the acromion.

2. Epiphyseal separations.

3. Distinct fracture of a large part of the process.

The sprain fractures are usually treated by prolonged rest with active diathermy, and not applications. Active motion should be begun early because of the danger of limitation of motion in the shoulder joint. Motions which are painful should not be urged. In the larger fractures of the acromion, the upper extremity must be immobilized for four weeks. In fractures of the glenoid cavity the arm is immobilized in abduction after reduction. Fractures of the neck are first reduced under general anesthesia, and are immobilized by a large axillary pad and a Velpeau bandage. Roentgenological examination will, of course, be made after the dressing has been applied to insure proper position of the fragments.

Fractures of the Ribs.—All fractures of the ribs save compound ones and those accompanied by severe crushing injury of the chest and its contents, may be considered as minor. Fractures of the ribs are caused by direct violence as from blows or crushing of the chest. Fracture may also be caused by muscular violence. The patient will at once be conscious of a severe, stabbing pain at the site of the fracture. This pain is greatly increased at each respiration. There is marked tenderness at the site of the fracture. In cases of suspected fractures of the ribs, it will be well to examine each rib separately. A useful routine is to make pressure upon each rib individually at some 2 or 3 inches away from the region of general tenderness. Pressure upon the fractured rib at this distance from the site of the fracture will cause pain at the fracture. Crepitus may sometimes be felt or heard by the stethoscope upon deep breathing. Subcutaneous emphysema may follow rib fractures. Hemoptysis may be present, but this may be

[1] Speed, Kellogg: Fractures and Dislocations, 2d ed., Lea & Febiger, 1928, p. 256.

caused by the coughing up of blood which has resulted from compression of the lung rather than from puncture of the lung by a broken rib. *x*-Ray examination in two or three planes, which must be made with particular attention toward the ribs, will show the injury.

The treatment of fractured ribs is strapping with adhesive plaster. The proper application of the adhesive strapping requires considerable skill on the part of the surgeon and a marked degree of co-operation on the part of the patient. If possible, the patient will best be treated standing but if too faint or weak, a sitting position is permissible. Two assistants will raise both arms to the level of the shoulder and will steady the patient, who is instructed to stand with his feet apart in a braced position. The hair having been shaved from the chest and the skin cleansed with benzine and dried, 3-inch wide strips of adhesive which are long enough to completely encircle the chest save for a space of 6 to 8 inches on the unaffected side, are applied. The first strip of adhesive is started high up on the chest and is fixed at the posterior axillary line on the unaffected side. The patient is then instructed to exhale completely his breath and to hold his breath in expiration as long as possible, and when breathing becomes necessary to do so as shallowly as possible. The top strip is then forcibly wound around the

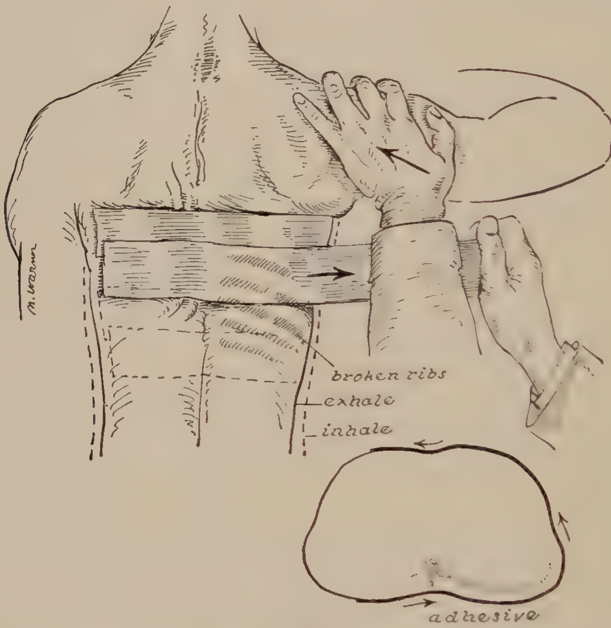

Fig. 145.—Method of strapping chest for a fracture of the rib. The straps are applied very firmly from the top downward while the patient holds his breath in exhalation.

chest and made tight (Fig. 145). The patient's shoulders should be braced and, if he be standing, his feet be held well apart. Without permitting the patient to take a deep breath the second strip is applied in the same manner overlapping the first strip for a space of 1 to 1½ inches. Subsequent strips are applied in the same manner until the entire side is strapped or, at least until the strapping reaches 4 or 5 inches below the site of the fracture. Webb[1] emphatically recommends the complete encirclement of the expired chest with adhesive for the first ten days. The success of the strapping depends upon the tightness and the smoothness with which it is applied. Folds and wrinkles in the adhesive, while to some extent unavoidable, if marked will cause considerable discomfort to the patient. In women the breasts should be carefully avoided. The edge of the adhesive which passes under the breast should be protected by a gauze pad. Straps of adhesive may be passed both under and over the breast. The straps should not pass over the epigastrium if possible. The almost instant relief from the severe pain is very gratifying. It is desirable to have this adhesive strapping remain in place for at least three weeks. The warmth of the body will often cause the adhesive to slip so that it no longer immobilizes the affected side. In this case, fresh strapping will have to be applied. Before this is done, however, the skin should be thoroughly cleansed and any cutaneous infections which have been discovered under the old adhesive will be appropriately treated. The complaint by the patient of pain and tenderness underneath the adhesive in a small locality should be investigated by cutting out a window of the adhesive. Boils and even carbuncles have been known to form under this adhesive strapping. Commercial elastic adhesive plaster ("Elastikon," Johnson and Johnson, New Brunswick, N. J.) is useful in strapping ribs, but probably gives less support than the rigid adhesive. In individuals sensitive to adhesive a tight chest binder will be tried.

A fairly common complication of fracture of the rib is contusion of the lung. The blood effused into the lung parenchyma will be visible in the *x*-ray and will generally absorb or be expectorated by the patient. Puncture of the lung by a sharp rib end may bring about a hemothorax, which if not too large, will absorb. Aspiration of the pleura, however, is indicated in some cases where the quantity of blood is large and there is embarrassment of respiration. A rare complication of rib fracture is ileus. The author has seen 1 case and there are some 4 others reported.

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[1] Webb, R. C.: Personal communication.

Strain of Costochondral Junction.—A very common injury which is the result of falls or blows upon the chest is a strain of costochondral junction. This condition is quite painful and has a marked tendency to chronicity. The only treatment of avail is immobilization by strapping with adhesive and the application of external heat.

Minor Fractures of the Sternum.—All linear fractures of the sternum without displacement may be regarded as minor fractures because their treatment is limited to rest. Strapping with adhesive is very unnecessary and, in fact, is of little use because to immobilize the sternum completely both sides of the chest would have to be immobilized and thus limit the breathing to the diaphragmatic type. This, however, occasionally is necessary.

Dislocations Involving the Trunk.—*Dislocations of the Clavicle.*—The clavicle may become dislocated from its sternal or scapular attachments. The dislocation from the scapula is rare, and its treatment involves the use of a posterior cross splint which will retract both shoulders and permit the clavicle to resume its normal position. The immobilization in this position will have to be maintained for at least four weeks. An open operation occasionally is necessary. Luxation of the claviculosternal articulation is more common and follows blows upon the shoulders, such as heavy falls. It is extremely difficult, if in fact at all possible, to maintain reduction of this dislocation by a pressure pad upon the central end of the clavicle. It will be necessary to treat this injury by the use of a clavicular cross splint or brace which strongly will retract the shoulders and permit the clavicle to resume its natural position. As in the dislocations of the outer end, the immobilization will have to be maintained for a prolonged period of time, four weeks being the minimum requirement. Open operation in this case is occasionally necessary. Mitchell[1] has never seen a patient who could play football after a dislocation of the outer end of the clavicle unless an operation had been efficiently performed.

The presence of a dislocation of the inner end of the clavicle is generally very easily established by palpation. The clavicle will be elevated from its normal position and in most cases quite readily may be reduced by simple pressure upon the projecting end. The end, however, will immediately become dislocated again as soon as pressure is removed.

Dislocations of the Vertebræ.—The vertebræ are attached to one another by extremely strong ligamentous structures, and when subjected to powerful violence are more likely to fracture than to become dislocated. Dislocation of the vertebræ occasionally does occur, and is distinctly a problem of major surgery. The mortality in reported cases is some 75 per cent. In many cases of dislocation of the vertebræ there is accompanying injury of the spinal cord.

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[1] Mitchell, A. B.: Brit. Med. Jour., 3440, 1097, December 11, 1926.

Dislocations of the cervical vertebræ are not exceedingly uncommon. The bilateral are usually fatal. The unilateral variety is generally benign and is often not recognized. In unilateral dislocation of the cervical vertebræ "an articular process slips over the articular process below it and either catches on top of the lower articular process or slips down in front of it."[1] The condition simulates a torticollis. The treatment of this condition is retrolateral flexion and rotation *without extension* (Walton). This is done under general anesthesia.

The dorsal and lumbar vertebræ, particularly, are capable of rotary motions upon themselves and upon this circumstance is based the elaborate philosophy of the osteopath who believes that subluxations may occur between all vertebræ and which should be treated by "adjustments." These subluxations are alleged to give rise to a wide variety of systemic symptoms, ranging from respiratory infections to constipation. It is extremely difficult to conceive that such may be the case, although the explanation offered by the osteopaths is that the subluxation causes a pinching or pressure upon the spinal nerves at their point of exit from the spinal foramina. Subluxation is known definitely to occur at the attachment of the fifth lumbar vertebra to the top of the sacrum or involving the fourth lumbar vertebra.[2] This subluxation is accompanied by pain at the site of the injury and by limitation in mobility of the back. It is often remedied by having the patient lie in the dorsal position and by exerting a sudden, forcible upward traction on the small of the back, which brings about an accentuated lordosis. The relief may be very prompt and marked. After this manipulation it will be necessary to either immobilize the spine with a lumbosacral belt or to have the patient spend a considerable period of time in bed, with the back arched in a position of lordosis.

Fractures of the Costal Cartilages.—Stimson,[3] who has collected an interesting series of cases from the literature, states that fractures of the costal cartilages "occur much more frequently at or near the junction of the cartilage and rib than at any other point, and more frequently in the seventh and eighth ribs than at any other point." The diagnosis is based upon localized pain and abnormal contour of the costal cartilage. The prognosis is excellent and union will generally take place in three or four weeks following immobilization with adhesive plaster.

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[1] Scudder, C. L.: Treatment of Fractures, 10th ed., W. B. Saunders Co., 1927, p. 1135.

[2] See article by Asbury, E.: Spondylolisthesis, with Especial Reference to the Cauda Equina, Jour. Amer. Med. Assoc., 1927, 88, 555.

[3] Stimson, L. A.: Fractures and Dislocations, Lea & Febiger, 7th ed., 1912, p. 202.

5. **Burns of the Trunk.**—The trunk is subjected to thermal, chemical, electrical, and radium burns, as are other regions of the body, and the treatment is the same as described in the section on burns.

6. **Hemorrhage from the umbilicus** may occur in newborn babies from inadequate tying of the cord. Such hemorrhage may be very serious and requires prompt clamping and religature of the cord. Hemorrhage from the cord may also occur at some time after the tying of the cord in cases where the granulating wound has become somewhat infected and the ligature either slips off or the infection may erode the umbilical vessels. In this case the control of the hemorrhage may be more difficult because the bleeding point will be difficult to grasp with an artery forceps. Various astringents and clotting agents will be used. Fused silver nitrate, ferric chloride, alum, and thromboplastin have been successful in controlling these hemorrhages. Occasionally it will be necessary to pass a deep stitch and so constrict the entire bleeding area.

II. INFECTIONS OF THE TRUNK

There are no peculiarities adherent in the commoner infections of the trunk, which differ from those in other localities of the body. Furuncles and carbuncles may be treated in the manner described in the section devoted to them. Likewise cellulitis and erysipelas will be treated as described elsewhere.

1. **Acute subpectoral abscess** is a collection of pus lying between the ribs and the pectoral muscles. This condition is most frequently due to metastatic infection (see the writer's case on p. 19). The symptoms are localized pain, tenderness, fever, leukocytosis, and limitation in the movements of the arm. The abscess may be drained through an incision which splits the fibers of the pectoralis major. Milch,[1] however, recommends incision and drainage along the lower border of the pectoralis major muscle.

The umbilicus is often the seat of pyogenic infections which may be very resistant to treatment owing to the deep ramifications of the skin folds of this area. Cleansing the depths of the umbilicus by the institution of hot boric fomentations will, in practically all cases, be successful. Incision and drainage will rarely be necessary.

Werthemann[2] has emphasized the fact that infections originating in the navel may be the cause of fatal complications even though the cutaneous navel shows no changes. Organisms may be transmitted to the liver without arrest in the umbilical vein. Because of these serious dangers, particular care must be taken of the umbilicus.

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[1] Milch, H.: Ann. Surg., 87, 517, 1928.

[2] Werthemann, A.: Schweizerische med. Wchnschr., 57, 609, June 25, 1927.

2. **Excoriations of the skin** such as those caused by scratching will be treated as abrasions in the manner described in the section on open wounds.

3. **Infections of the Mammary Gland.**—(*a*) *Infection of the Nipple.*—The nipple may become infected through minute wounds occasioned by the traumatism caused by nursing. These may bring about a diffuse cellulitis of the nipple or an ulceration and fissure formation. The fissures may show little or no infection but may be extremely painful during nursing. In the case of both infections and fissure formations, nursing will be discontinued until the condition is remedied. Hot boric fomentations will be useful in the case of diffuse inflammations of the nipple. A useful agent in the treatment of fissures of the nipple will be the periodic painting with compound tincture of benzoin. In either event strict attention to cleanliness and asepsis must be taken.

Paget's Disease of the Nipple.—In this condition, which occurs chiefly in women over forty, the skin of the nipple and the area around it becomes reddened and is followed by desquamation. "Infiltration soon produces a bright red, granular, indurated surface, with a sticky yellowish discharge which, by forming crusts, may obscure the nature of the lesions save at the border, which continues to be characteristic—sharply defined, indurated, and sometimes distinctly raised."[1] It is known that cancer of the breast will follow Paget's disease of the nipple, and by some[2] it is believed that "Paget's cells" are cancerous from the beginning. Paget's disease has been found in regions remote from the nipple.[3] Muir[4] believes that "Paget's disease is the result of the invasion of the epidermis of the nipple by tumor cells of glandular type which reach it from the upper extremities of the lactiferous ducts affected by neoplastic disease. These tumor cells constitute the 'Paget cells.' Their growth is intra-epidermal." Once the diagnosis of Paget's disease of the nipple may be made, prompt and total removal of the breast is indicated.

(*b*) *Acute and Chronic Mastitis.*—Acute mastitis occurs most frequently in nursing mothers and may or may not go on to abscess formation. It is manifested by pain, swelling, and redness of the affected parts. It may or may not be somewhat localized. Many cases of early acute mastitis may be completely cured by the discontinuance of nursing, the elevation of the breast, the application of hot boric fomentations. Chronic mastitis may occur quite independently of the lactation period, and is evident by the presence of tender nodules in the breast. Hot applications and elevation of the breast is the treatment of choice.

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[1] Harris, Malcolm: Index of Differential Diagnosis, William Wood & Company, 1917, p. 730.

[2] Pautrier, L. M., Levy, G., and Diss, A.: Presse Méd., 35, 993, August 13, 1927.

[3] Pautrier, L. M., Levy, G., and Diss, A.: Presse Méd., 35, 1041, August 24, 1927.

[4] Muir, R.: Jour. Path. Bact., 30, 451, 1927.

Examination of the Breast.—It is extremely important to adopt a routine manner of examination of the breast. By far the best method is to have the patient lying flat on the table in a dorsal position. The breast is then examined in a methodical manner so that all areas are palpated. Three or four fingers or the flat of the palm is used and the breast tissue is pressed against the underlying chest wall. It will never be advisable in the search for masses in the breast to pick up the breast itself between the thumb and forefinger, as the normal breast tissue very frequently will simulate the presence of a mass or tumor. A "mass" or "tumor" which has been elicited by this latter method will generally disappear when the breast is pressed flat against the chest wall.

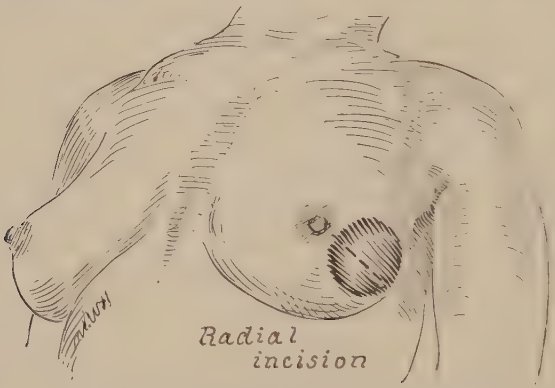

Fig. 146.—Radial incision for breast abscess.

(*c*) *Mammary Abscess.*—Abscesses of the mammary gland most commonly occur during the period of lactation. The patient is conscious of a painful area in the breast which soon becomes indurated, red, and extremely tender. At this stage of the inflammation incision is not indicated but treatment by elevation and hot fomentations will be the choice until fluctuation or other definite indications of the presence of pus are apparent. The common error in the drainage of breast abscesses is to make the incision too small. The incision should extend well beyond the actual pus cavity. In large abscesses incisions 2 to 4 inches in length will be indicated. Multiple incisions connected by rubber drainage-tubes or rubber dam may be advisable. All such incisions should be made radially from the nipple (Fig. 146). The abscess cavity will be loosely packed with vaseline gauze, which will not be removed for two or three days, during which hot fomentations have been maintained. Decreasing quantities of packing, loosely inserted, will be used until a clean granulating surface presents.

(*d*) *Tuberculosis of the mammary gland* is slow in onset and has a chronic course. It may be painful or painless. The breast is usually small and nodular. Tuberculous abscesses may form and discharging sinuses result. DaCosta[1] says that the best treatment is to remove the mammary gland and to clear out the axilla.

(*e*) *Traumatic Fat Necroses of the Mammary Gland.*—This interesting condition was first described in 1920 by Lee and Adair.[2] A tumor appears in the breast following an injury, usually a hypodermoclysis. This tumor, which formerly was mistaken for carcinoma, is in reality the result of an inflammatory reaction around an area of necrotic and liquefied fat. The resemblance to carcinoma may be close, although the mass is fairly well circumscribed. The tumor is extremely hard and in Lee and Adair's cases was fixed to the skin in 4 cases and to the deeper structures in 2. The tumor may appear from three weeks to ten years after the receipt of the trauma. The tumor is benign and local excision under local anesthesia will suffice for the treatment. The gross appearance is given by Boyd[3] as follows: "The affected area is opaque, and may show one or more cysts containing liquefied fat; or the center may be simply somewhat diffluent. The area is more or less encapsulated; at least there is no evidence of infiltration. The cicatricial contraction and the yellow points and streaks of carcinoma are not observed. Although on a superficial examination there may be a resemblance between the gross appearance of carcinoma and traumatic fat necrosis, a careful study will reveal essential differences. It is possible to make a correct diagnosis on the operating table from the gross appearance." The microscopic picture is one of chronic productive inflammation in the fat. Foreign body giant cells are numerous. There are areas of necrosis and liquefaction in the fat.

4. **Adenitis.**—(*a*) *Axillary Adenitis.*—The differential diagnosis between axillary adenitis and axillary furunculosis may be extremely difficult and these two conditions are very frequently coincident. These

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[1] DaCosta, J. C.: Keen's Surgery, W. B. Saunders Co., 1, 652, 1916.

[2] Lee and Adair: Ann. Surg., 72, 188, August, 1920.

[3] Boyd, William: Surgical Pathology, W. B. Saunders Co., 1925, p. 562.

circumstances are apt to make the treatment somewhat perplexing. The ordinary treatment of an enlarged and inflamed inguinal lymph-node is the use of cold applications with appropriate treatment of the source of infection. Cutaneous infections and furuncles are best treated by the employment of hot hypertonic solutions. The poulticing of an inflamed inguinal lymph-node in some cases is unwise because it tends to bring about a breaking down of the lymph-node with suppuration and abscess formation. The chief reason of the enlargement of the axillary lymph-nodes, however, is the presence of an overlying furunculosis and it has seemed wiser to treat the furunculosis by hot boric fomentations and in clearing them up to relieve secondarily the axillary adenitis which they had caused. Where the hot boric fomentations have been employed for some time and where the furuncles may show a definite abscess formation, these should carefully be incised with a very sharp knife and a small gauze or rubber tissue drain inserted. The boric fomentations will be continued after incision has been made. Cases of axillary adenitis which arise from remote infections, as those of the hand and arm, will be treated by cold applications and by attention directed to the primary source of infection. In some cases the inflammation involving the axillary lymph-nodes will progress long after the causal inflammation has subsided. The writer has seen such inflammation progress to abscess formation as large as a hen's egg, long after the subsidence of an infection on the hand. Where abscess formation has taken place in the axillary lymph-nodes, wide incision of the abscess with the institution of drainage is indicated. A convenient

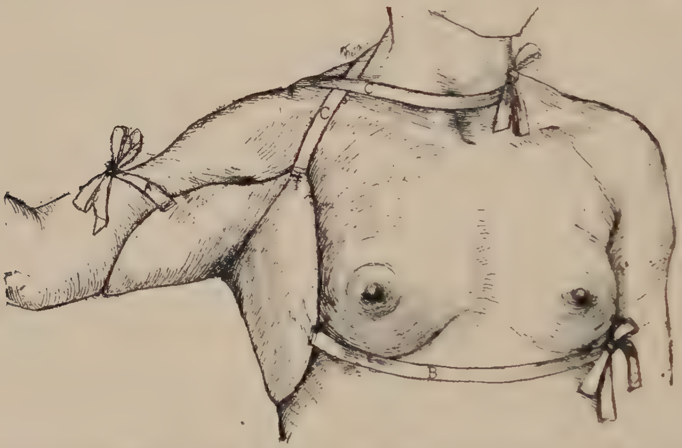

Fig. 147.—A convenient axillary dressing made from a dress shield. (Butler, E. F., Jour. Amer. Med. Assoc., April 30, 1927.)

axillary dressing has been devised by Butler.[1] This consists of a "dress shield" to which six tapes are sewed (Fig. 147). Chronic axillary furunculosis is often benefited by x-ray therapy (Fig. 148).

(*b*) *Inguinal adenitis* is a common sequel of pyogenic infections of the lower extremity or of infections, particularly venereal, involving the genitalia. The best treatment of the incipient adenitis will be measures directed at the primary source of infection. Hot boric fomentations of infections of the extremities will often bring about a quick subsidence of the inguinal adenitis. The pain and swelling will rapidly disappear. Likewise measures directed to the treatment of venereal disease will cause an alleviation of the symptoms. In many cases of chancroid and gonorrhea the inguinal adenitis will progress to abscess formation, and a *bubo* will result. Patients with abscess formation of the inguinal lymph-nodes should be treated by rest and hot fomentations if the condition has progressed so far that suppuration is inevitable. When fluctuation is apparent, incision and drainage will be employed. The incision should be of generous size and the loose gauze

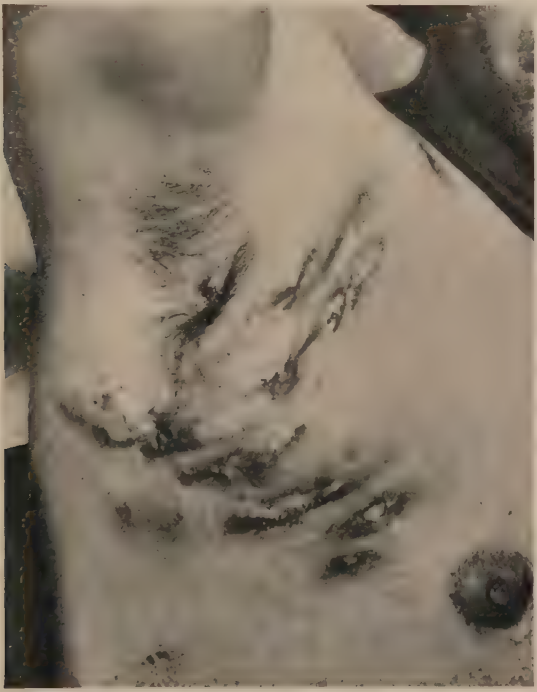

Fig. 148.—Tuberculosis of the skin. (Scrofuloderma.) (Courtesy of Dr. Francis Senear.)

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[1] Butler, E. F.: Jour. Amer. Med. Assoc., 88, 1395, April 30, 1927.

packing should be changed daily. In the incising of abscesses in the inguinal region it will be well to keep in mind the proximity of the femoral vessels, so that the scalpel will not be carried too deeply with the danger of injuring them.

5. **Infections of the Pleura.**—(*a*) *Pleurisy with Non-purulent Effusion.*—In pulmonary tuberculosis, in mediastinal tumors and in other more rare affections, a non-purulent effusion into the pleural cavity will take place. The presence of this fluid is indicated by some embarrassment of respiration, by dulness on percussion, and by the *x*-ray findings. Its removal is indicated for the relief of respiration or to obtain some of the fluid to aid in making a diagnosis. *Aspiration of chest* will vary somewhat in accordance with whether a large or small quantity of fluid is desired. A simple diagnostic aspiration may readily be carried out with a 20-c.c. Luer syringe and a needle some 2 inches in length, and of at least 19-gauge caliber. The skin is first carefully cleansed and painted with antiseptic solution for a wide area about the site of aspiration. The site of aspiration is determined upon by percussion, which may be done either before or after the skin is prepared. The site of the puncture should be either in the sixth interspace in the midaxillary line or in the eighth interspace in the scapular line.[1] A small wheal of local anesthetic solution is made in the skin with a fine needle. Local anesthesia is then further produced by introducing the needle vertically beneath the skin wheal and infiltrating the underlying muscle and parietal pleura. The patient is then placed in a sitting position and steadied by assistants with the arms well elevated. The aspirating needle with syringe attached is then introduced into the infiltrated area. It is important to hold the needle and syringe firmly in both hands because considerable pressure is required before the skin is punctured and unless precautions are taken to prevent the needle going in too rapidly after the forceful penetration of the skin, it will enter the pleural cavity too deeply. Too deep penetration may cause a wound of the lung and possibly a resultant pneumothorax. The entrance into the pleural cavity is appreciated by the surgeon by the sudden removal of resistance to the needle point. Aspiration of the desired quantity of fluid is then effected.

Where it is desired to remove a larger quantity of fluid more elaborate preparations must be made. The best method is the employment of a Potain aspirator. The aspirating needle is attached to a rubber hose which in turn is connected to a large flask or bottle, in which negative pressure has been produced by the action of a suction pump

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[1] Phillips, John: Cecil's Text-book of Medicine, W. B. Saunders Co., 1927, p. 848.

(Fig. 149). By continuously extracting air from the negative pressure bottle, the chest fluid will be caused to flow into the bottle until the desired amount has been removed and the aspirating needle is then withdrawn. This method has two great advantages. The first is that the closed system obviates the possibility of the introduction of air into the pleural cavity and its constant danger of causing collapse of the lung The second advantage is that the rate of withdrawal may be very definitely controlled and on the appearance of any symptoms of syncope on the part of the patient, the withdrawal may be stopped or retarded. In the absence of a Potain aspirating outfit, the surgeon will use a series of 50-c.c. Luer syringes. After one has been filled with pleural fluid, it will be detached from the needle and handed to an assistant and a second syringe quickly attached to the needle. During the transfer of the syringes which should be effected as quickly as possible, the gloved thumb or finger should be placed over the needle to prevent the ingress of air. Webb[1] says that familiarity with artificial pneumothorax has changed our ideas of the dangers of ingress of air in the pleural cavity. In cases of tuberculous pleurisy where the accumulation of fluid takes place rapidly, the fluid may be replaced with air and the rate of accumulation decreased.

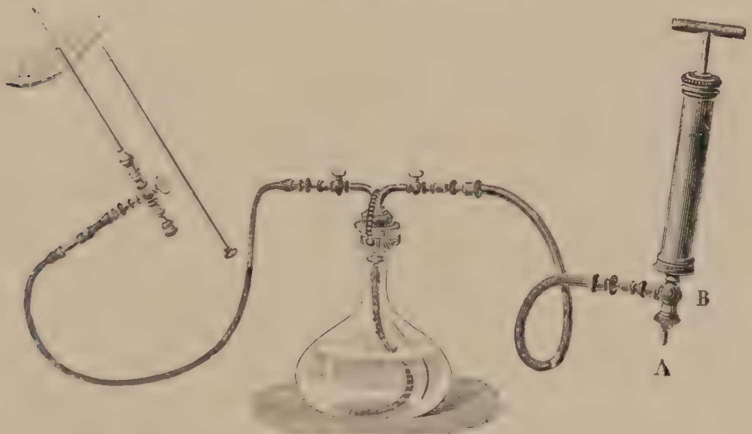

Fig. 149.—Potain aspirator. (Maisonnet, "Petite Chirurgie.")

(*b*) *Pleurisy with Purulent Effusion, i. e., Empyema.*—The treatment of empyema varies with the age of the patient, with the quantity of pus in the pleural cavity, and with the familiarity of the surgeon with the method to be employed. Empyema most frequently occurs after pneumonia. The failure of the temperature to subside, the presence of dulness in the chest, the x-ray pictures of the chest which should always be taken in the upright position and *a diagnostic aspiration* will establish the diagnosis. In some cases in young children the repeated daily aspirations with a Luer syringe may bring about a cure. Brilliant results have been obtained by Dr. Joseph Brennemann at the Children's Memorial Hospital of Chicago by this method. In other cases the "closed method" is to be employed. According to Bettman[1] there are three great advantages in the closed method of treating empyema. "(1) The method is simpler and safer than any other. (2) The convalescence is shorter, more comfortable. (3) The occurrence of chronic empyema is less frequent." This method consists essentially in the introduction of a small rubber catheter between the ribs by means of a trocar. The trocar is withdrawn, leaving the catheter in place. This catheter is made fast to the skin surface by means of adhesive plaster. The technic is described in detail by Bettman[2] as follows:

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[1] Webb, R. C.: Personal communication.

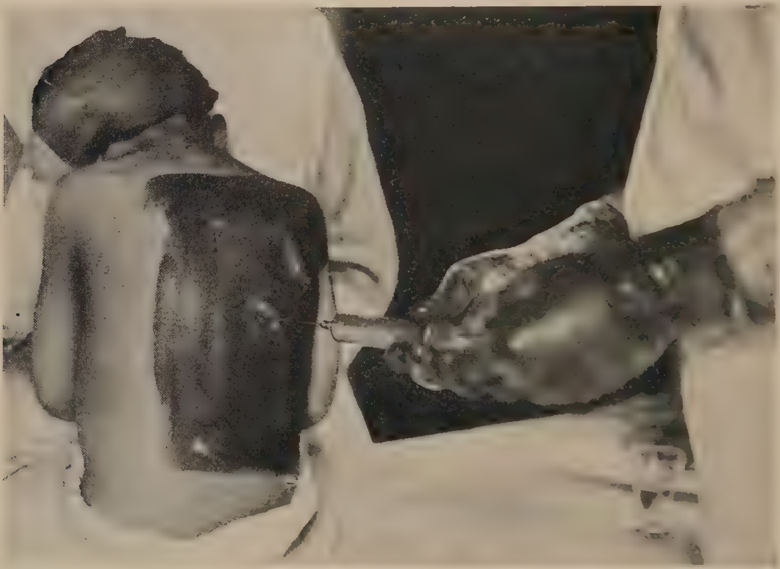

Fig. 150.—Closed method of treating empyema. The skin and subcutaneous tissues are infiltrated with local anesthesia. (Courtesy of Dr Ralph B. Bettman.)

"A small skin wheal is first made—procaine $\frac{1}{2}$ per cent. without adrenaline is our anesthetic of choice. The subcutaneous tissues are next generously infiltrated. Then with a long, large bore needle on a 20-c.c. Luer syringe the deep intercostal tissues are anesthetized. The solution is forced out as the needle is gently pushed ahead, infiltrating the path of the needle (Fig. 150). In this way the pleural cavity is entered with practically no pain. As soon as the needle has entered the pleural cavity, aspiration is attempted. If the fluid aspirated is thin, fairly clear, and more the type of a serous fluid than frank pus, it is much better to postpone drainage, relying on repeated aspirations until the patient shall be cured or the fluid have changed into definite pus. If the fluid, on the other hand, is thick, greenish, and definitely purulent, the operation is continued as follows: The skin is nicked with a sharp scalpel at the site of the needle puncture. The needle is now withdrawn and a trocar forced through the intercostal space along the anesthetized tract (Fig. 151). A catheter, which before the operation had been found to fit snugly in the trocar, is pushed through the trocar into the chest cavity the moment the obturator of the trocar is withdrawn (Fig. 152). The end of the catheter is clamped with a hemostat. It is wise to boil the catheter first before trying to fit it with the trocar, because the boiling swells the catheter and a catheter which cold will be found to fit, after boiling will sometimes be found too large. A trocar which will take an F. 14 soft-rubber catheter is the kind we have found very satisfactory. The sheath of the trocar is now withdrawn, leaving the catheter in the chest wall. The catheter is clamped near its emergence from the chest wall—the funnel end is cut off and the

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[1] Bettman, R. B.: Illinois Med. Jour., December, 1926.

[2] Bettman, R. B.: Illinois Med. Jour., February, 1924.

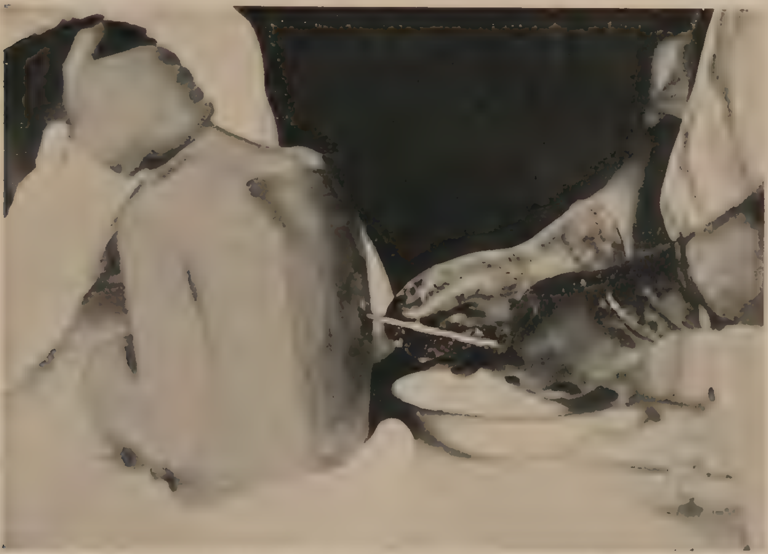

Fig. 151.—Closed method of treating empyema. Introduction of trocar into empyema cavity. (Courtesy of Dr. Ralph B. Bettman.)

trocar removed (Fig. 153). This funnel end is then rethreaded on the catheter and acts as a cuff which firmly fits about the catheter at its

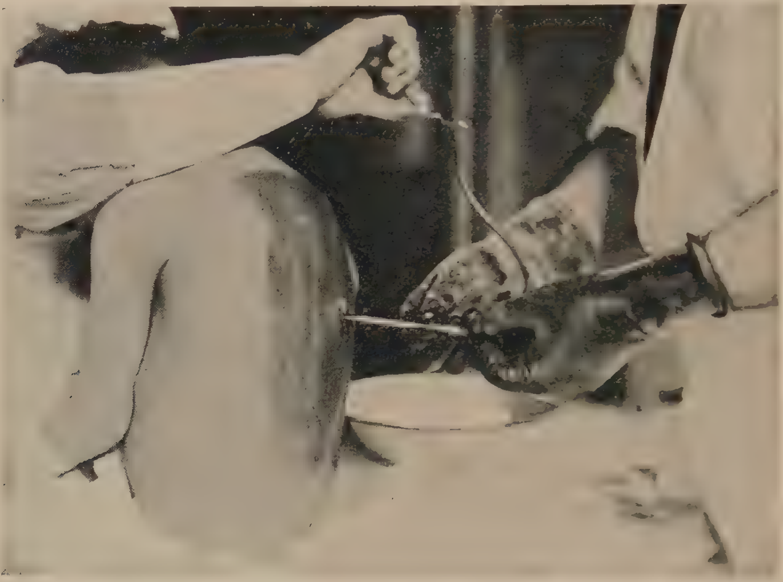

Fig. 152.—Closed method of treating empyema. Obturator of trocar has been removed and catheter is being inserted. (Courtesy of Dr. Ralph B. Bettman.)

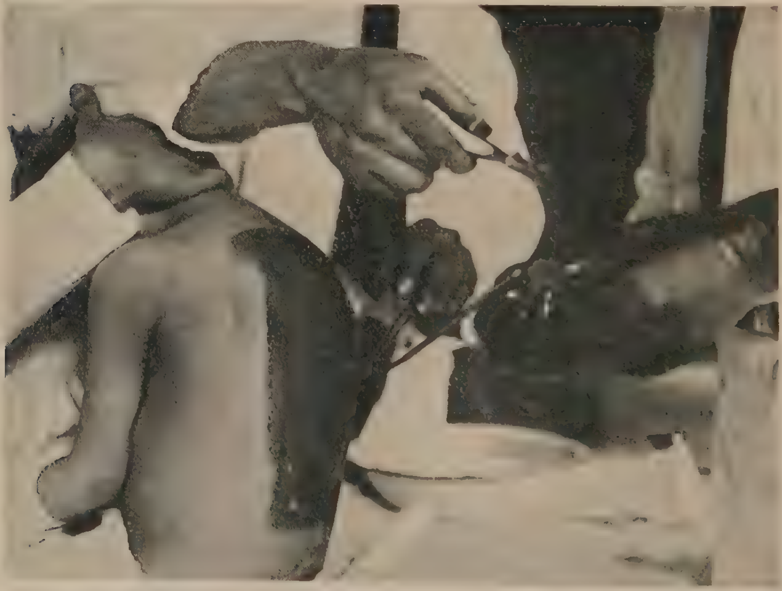

Fig. 153.—Closed method of treatment of empyema. Catheter clamped at proximal end and trocar withdrawn. Flaring end of catheter cut off. (Courtesy of Dr. Ralph B. Bettman.)

emergence from the chest wall. A safety-pin can be pinned through this cuff without going into the catheter itself, thus the air-tight technic is not broken. Two small bits of gauze at each side of the catheter and two adhesive bands complete the dressing" (Figs. 154–156). A thoracic binder may be used. Bettman says that the after treatment is the most important part of the operation. "Continuous care and watchfulness are necessary. Every two hours the chest is aspirated through the catheter, not more than a few ounces at the utmost being aspirated at any one time. In order to liquefy the pus and dissolve the large thick fibrin flakes so that the catheter will not be blocked, Dakin's solution is used. After each aspiration a certain amount of Dakin's solution is injected into the empyema cavity, usually about one-third the amount of pus aspirated. The aspiration and injection are done with due regard to the maintenance of air-tight technic. The catheter is maintained in place until after the fluid aspirated has been shown to be bacteria free on three successive days. Then the catheter is withdrawn and the opening sealed with adhesive." It may be attached to a flask or bottle in which a negative pressure is maintained. As pointed out by Koch it is important to see that this negative pressure does

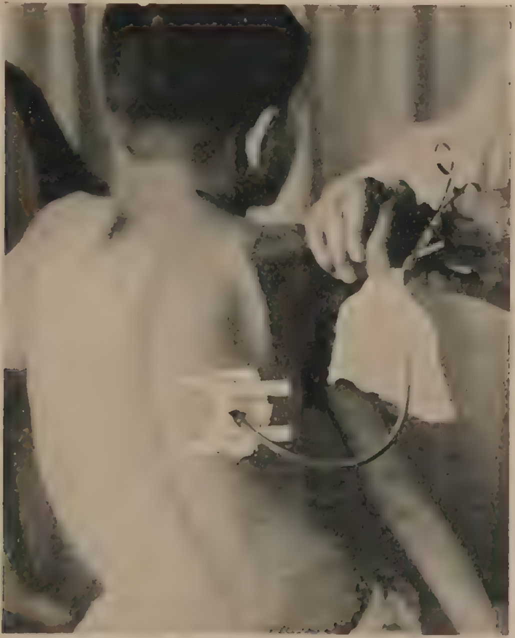

Fig. 154.—Closed method of treating empyema. Rubber collar slipped over catheter and fastened to dressing with a safety-pin. (Courtesy of Dr. Ralph B. Bettman.)

not become too strong and safety devices to prevent its becoming so should be used.

The alternative to the closed method is the "open method." This consists of the introduction of a large rubber drainage-tube into the

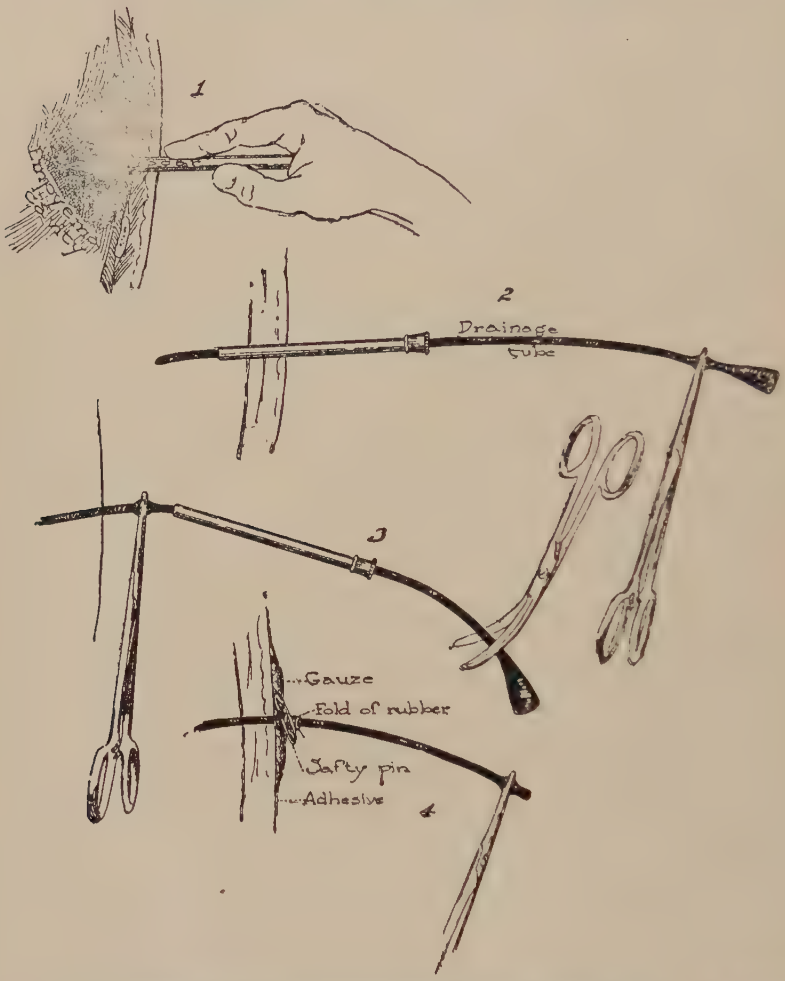

Fig. 155.—Diagram of the closed method of the treatment of empyema. 1. Method of introducing trocar into empyema cavity. 2. Catheter introduced into trocar. 3. Trocar withdrawn over catheter. 4. Catheter held in place by rubber collar and safety-pin to dressings. (Bettman, Ralph B., International Clinics, vol. i, Series 33, 1923, J. B. Lippincott Co., Publishers.)

pleural cavity without effort to prevent the introduction of air. It is particularly suitable in cases where the empyema cavity is well walled-off by strong adhesions. The rubber tube is either introduced between the ribs or in a space made by the resection of a rib. A sedative drug should precede the operation. Local anesthesia will be the choice except in very nervous patients, where ethylene or nitrous oxide and oxygen will be desirable. Children may be allowed to sit up in the cases operated upon under local anesthesia. Lilienthal[1] says that the incision should be parallel to the rib in the posterior axillary line, or 1 or 2 inches behind it, and better a little too high than too low. "The danger of performing a transdiaphragmatic laparotomy is greater than might be imagined" (Lilienthal). The dissection should be carried out carefully, and kept close to the border of the rib below the interspace. The pleura is punctured with a scalpel and slowly spread with a hemostat until it will admit a No. 14 or No. 16 French multifenestrated soft rubber tube. The latter may be connected to a collection bottle. When a rib resection is desired, the periosteum of the rib must be carefully anesthetized (in local anesthesia cases) both at its upper and lower aspects. A longitudinal incision of the periosteum is then made and it is separated from the rib for a distance a little beyond the intended

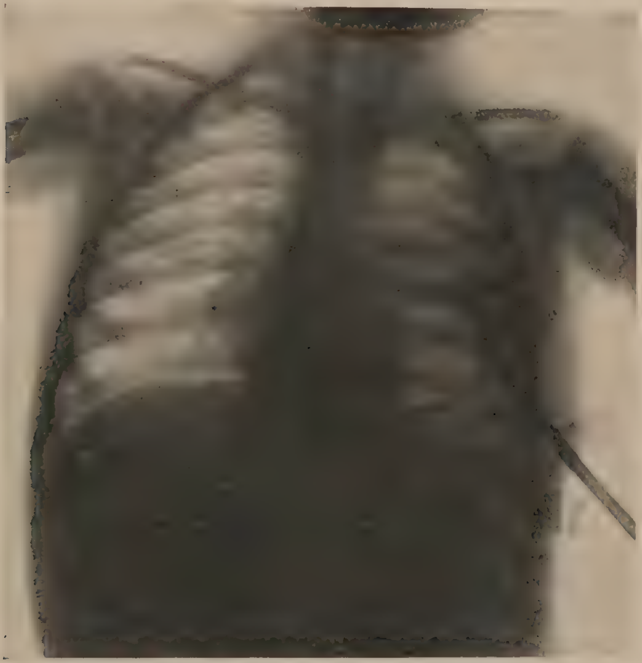

Fig. 156.—Closed method of the treatment of empyema. *x*-Ray showing catheter in empyema cavity.

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[1] Lilienthal, H.: Thoracic Surgery, W. B. Saunders Co., 1, 639, 1926.

rib resection. The rib is then cut with a curved rib cutter and the pleura incised as in the operation where the rib is not cut. In cases where the open method is employed it will be profitable to daily instil a small quantity, 10 to 20 c.c. of Dakin's solution and cause it to be expelled by having the patient cough or deeply inspire.

During the convalescence the patient should be instructed to use blow bottles (Fig. 157) daily. Children will do well inflating rubber balloons. The purpose of these exercises is to accelerate the expansion of the lung and in consequence, decrease the size of the abscess cavity. It is important to see that measures to improve the general health are carefully carried out.

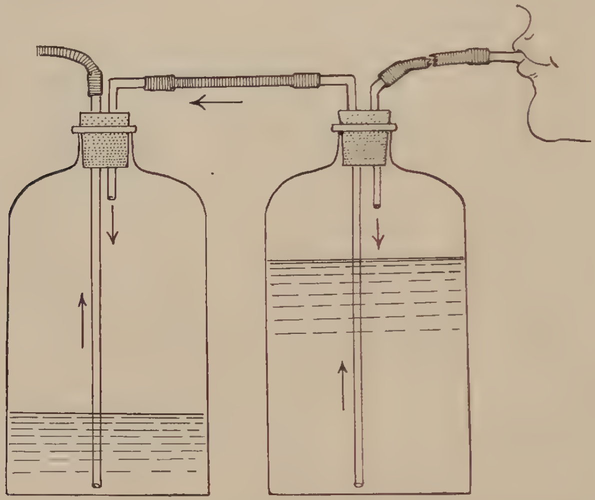

Fig. 157.—"Blow bottles" used in the treatment of empyema cases. The patient blows the water from one bottle to another, thus facilitating lung expansion and obliteration of the empyema cavity.

FIRST AID IN MAJOR SURGICAL ACCIDENTS OF THE TRUNK

In crushing injuries of the chest the essentials of the first-aid treatment will be the combating of shock and the support of circulation and respiration. It may be necessary to prop the patient up on pillows to facilitate respiration, despite the fact that this measure is contraindicated in cases of shock. Caffeine, camphorated oil, and digifolin may be exhibited.

In cases of suspected fracture of the spine the first-aid treatment will be the careful transportation of the patient to the hospital provided he is not so badly shocked that removal has to be deferred. The same great care in transportation so as to minimize movement of the affected parts will be observed as has been described above.

In cases of severe contusions of the abdomen, with probable rupture of a viscus the patient should be transported to the hospital as rapidly as is possible, unless he be in such grave state of shock that a short interval of antishock treatment may be justifiable. In cases of evisceration either through the rupture of a surgical incision or through penetrating, lacerating wounds, an attempt should be made to replace the viscera and to compress the wound edges by a tight binder, before the patient is transported to the hospital. The writer knows of a case of postoperative evisceration where the child's intestines hung out between the bars of its crib. They were replaced by the nurse and the intern, while the child was in a warm bath, before the attending man reclosed the abdomen.

In cases of suspected perforated gastric, duodenal, or small bowel ulcers, where the patient presents sudden agonizing pain and board-like rigidity, the first-aid treatment consists in the administration of morphine and the prompt removal to the hospital. Morphine should, however, not be administered unless the diagnosis has been made. The masking of the symptoms with morphine may have dangerous or fatal consequences.

Where there is evidence that causes suspicion of a fracture of the pelvis, the first-aid treatment consists essentially in the safe transportation of the patient to the hospital. As in cases of fracture of the spine the minimum amount of motion is desirable. To this end the placing of the patient upon a mattress and the mattress in turn upon a stretcher or upon a door is to be commended.

CHAPTER XIV

TUMORS AND DEFORMITIES OF THE TRUNK

I. TUMORS

1. **Benign Tumors.**—The trunk is the site of certain benign tumors which are found elsewhere in the body. Papillomata, fibromata (Fig. 158) sebaceous cysts, dermoids, lipomata (Figs. 159–161), and keloids require no different treatment because of their situation on the trunk. Certain other tumors peculiar to the trunk require special mention. Desmoids are very hard and tough fibromata, originating in the rectus abdominalis muscle. They are benign and the smaller ones may be readily removed under local anesthesia. The umbilicus is the site of umbilical cysts which likewise are readily treated by excision under local anesthesia. Chronic infection involving the umbilicus may produce a granuloma of this region which will require cauterization and occasionally excision for its removal. A patent omphalomesenteric

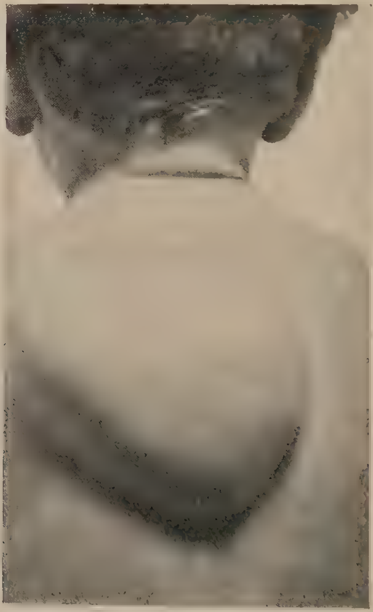

Fig. 158.—Fibroma of the back. (Children's Memorial Hospital, Chicago. Courtesy of Dr. A. H. Montgomery.)

duct may be the origin of an intestinal fistula at the umbilicus, but its treatment is a major surgical problem.

(*a*) **Tumors of the Nipple and Areola.**—Sebaceous cysts originating in the glands of Montgomery are the most frequent tumors in this region.[1] Papillomata and angiomata are occasionally found. These small benign tumors are readily removed under local anesthesia.

(*b*) **Macromastia or Hypertrophy of the Breast.**—The lesser degrees of this ailment are treated by a supporting binder, but occasionally the breast may reach such tremendous size as to require amputation for the convenience of the patient. The various plastic operations which have been devised to modify the size and shape of the breast are in the province of major surgery.

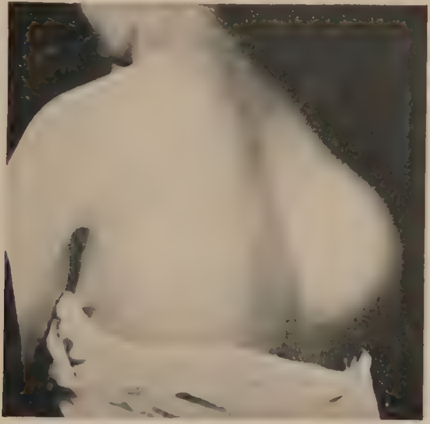

Fig. 159.—Lipoma of back. (Surgical Dispensary, Northwestern University Medical School. Courtesy of Dr. John A. Wolfer.)

(*c*) **Adenomata and Fibro-adenomata of the Breast.**—The existence of fibro-adenomata in the female breast is extremely common. They also occur uncommonly in the male breast. The diagnosis is made by palpation of a hard, definitely circumscribed, single or multiple rounded tumor in the breast tissue. This nodule will be found adherent neither to the skin nor to the underlying pectoralis major. It is generally freely movable.

Ewing[2] describes the *papillary intracystic fibro-adenoma* or *cystadenoma*. Typically it is enclosed in a cyst wall. "The tumor may appear as a papillary growth attached to one segment of the wall and incompletely filling the cyst, or it may occupy the entire cavity distending the wall, or numerous points of fusion unite the tumor with the wall. These tumors develop by papillary growths into the larger ducts" (Ewing). They may be accompanied by a bloody or serous discharge from the nipple. Hart[1] studied 124 cases of intracystic papillomatous tumors of the breast. There were 104 benign and 24 malignant tumors. Hart says that in the benign papillomatous cyst there is a nipple discharge, usually bloody, in 66 per cent. of the cases. "This tumor sometimes gives a nipple discharge without a palpable nodule. This discharge alone demands close observation, but it is not an indication for operation." Ninety-eight per cent. of the tumors are in the female breast: the duration may be as high as thirty years: they are generally found in the central zone of the breast." "They may have a firm, nodular, and indurated consistency, due to multiple cysts, densely filled with fluid and so situated as to suggest a single tumor. They occurred as a single tumor in 83 per cent. of Hart's cases. While usually small they were over 6 cm. in diameter in 38 per cent. of the cases. There

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[1] Finney, J. M. T.: Keen's Surgery, 3, 571, 1916, W. B. Saunders Co.

[2] Ewing, James: Neoplastic Diseases, 3d ed., 1928, p. 536.

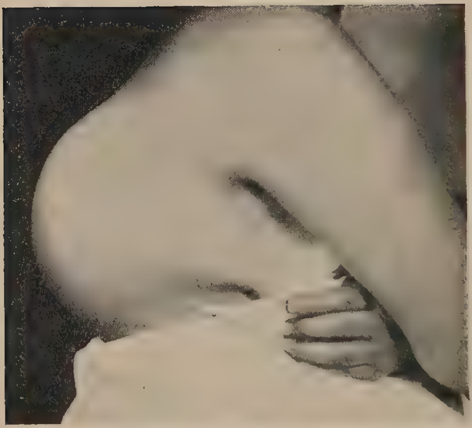

Fig. 160.—Lipoma of back. (Surgical Dispensary, Northwestern University Medical School. Courtesy of Dr. John A. Wolfer.)

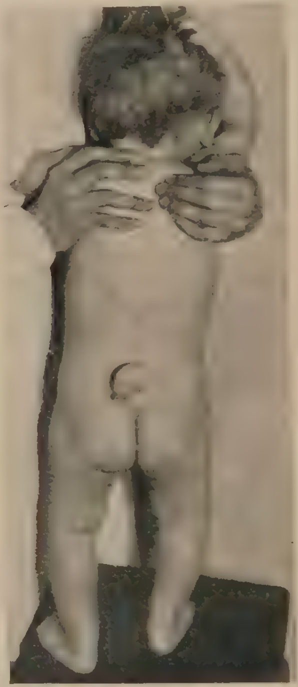

Fig. 161.—Lipoma of back. (Children's Memorial Hospital, Chicago. Courtesy of Dr. Joseph Brenneman.)

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[1] Hart, D.: Arch. Surg., 14, 793, April, 1927.

may be retraction of the nipple. Change in size of the tumor associated with a bloody nipple discharge is almost pathognomonic of a papillomatous cyst. Pathologically, there is usually a cyst with one or more papillomas, a thin wall, and no invasion. The interesting condition known as *fibrosis mammæ diffusa* which is a hyperplasia of the connective tissue has been studied by von Gusnar.[1] From a review of recent literature on cysts of the breast and his experience with 375 cases of this condition, Bunts[2] draws the following conclusions:

1. It is probable that all cystic conditions of the breast are due to the same primary cause; therefore a classification of benign cystic conditions is of neither etiological nor clinical importance.

2. It is possible that the same etiological factors that produce cystic conditions of the breast also produce carcinoma, but there is no final evidence at the present time that cysts of the breast *per se* are proemial in character.

3. It appears evident that, at least in certain cases, cystic conditions of the breast, in common with other types of benign tumors, may be due to intestinal toxemia.

4. The indicated treatment of cystic conditions of the breast may be summarized as follows:

(*a*) In cases of diffuse chronic cystic mastitis in women under thirty years of age a waiting policy may be adopted. After the age of thirty years the breast should be examined at intervals of not more than six months to determine whether there are signs of a recurrence of the cysts or the initiation of a malignant growth.

(*b*) Single cysts should be removed and subjected to histological study. If the growth proves to be benign, nothing further need be attempted, but the patient should be examined at frequent intervals to determine whether there is a cyst elsewhere in the same breast or in the other breast.

5. In the presence of a cystic condition of the breast, the possibility of carcinoma should be borne in mind. Cheatle[3] has studied fibroadenomata, and classifies them into intra-elastica and extra-elastica. When the diagnosis is established histologically, local removal is permissible.

Despite the fact that the ordinary symptoms which would suggest malignancy, dimpling of the skin, enlargement of axillary lymph-nodes, loss of weight, etc., be absent, it is of extreme importance to remove all lumps with a small portion of the surrounding tissue, from the breast for a definite microscopic diagnosis. It is impossible to exclude the diagnosis of carcinoma by palpation. The proper procedure in cases of this type is to inform the patient that she or he has a tumor of the breast which most likely is benign, but which should be removed for their protection because of the inability to make a positive diagnosis without the aid of the microscope. In every case it will be necessary to secure from the patient consent for a radical amputation of the breast in case malignancy is uncovered in the local removal of the nodule. Whereas the removal of small adenomata from the breast under local anesthesia is in itself a distinctly minor surgical procedure, the fact that not infrequently it is necessary to continue the operation and under the *same anesthesia* go on to a radical amputation, it removes from the class of minor surgery all tumors of the breast. The patient will be anesthetized with ethylene anesthesia and the nodule quickly excised. Without permitting the patient to awaken from the anesthetic the excised tumor is submitted to the pathologist for an opinion. Occasionally he will have to make a frozen section to determine the nature of the growth. On assurance that the growth is benign, the surgeon who has previously closed the small wound with interrupted silk sutures will allow the patient to come out of the anesthetic. If, however, the growth be pronounced malignant, he will proceed to do a radical operation.

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[1] von Gusnar, Kurt: Deutsche Ztschr. f. Chir., 199, 171, November, 1926.

[2] Bunts, F. E.: Ohio State Med. Jour., 22, 209, 1926.

[3] Cheatle, G. L.: Arch. Surg., 13, 617, November, 1926.

In the Archives of Clinical Cancer Research Bloodgood[1] has given some excellent advice on the diagnosis and treatment of *breast tumors*. The following is a portion of the abstract of his article by Steinke[2]:

"Bloodgood states that the patient to be examined for a pathological condition of the breast should be told not to inform the physician before the examination which breast is affected. With the patient stripped to the waist, a careful inspection of the nipple, areola, skin, and axilla should be made in both the reclining and the upright positions. First both breasts and then one breast at a time should be palpated in both positions. Gentle pressure should be made to see if there is any discharge from the nipple. When this examination has been completed, the patient should be questioned.

"Whatever its character or intensity, pain alone is of no diagnostic value. The excision of a painful scar is justified only when nerves are caught in the scar or there is a definite fibroneuroma of the nerve ends. When the woman who feels a lump or thinks she feels a lump in the breast, comes for examination at once, there is a 50 per cent. chance that what she feels is only part of a lumpy breast, but if the lump she feels is a definite lump, the chances are more than 50 per cent. that exploration will not reveal a cancer. If a cancer is found, the chances are that the glands are not involved, and the probability of a cure will be at least 70 per cent. The chances of a five-year and a permanent cure are best when the duration of the lump is less than a month. Metastasis to the axillary glands means a drop in the chance for a five-year cure from 70 to 25, 20, or 10 per cent.

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[1] Bloodgood, J. C.: Arch. Clin. Cancer Research, 1925, i, 1.

[2] Steinke: International Abstract of Surgery.

"Bloodgood had been unable to convince himself that *x*-ray treatment after operation or when the symptoms of metastasis are revealed has increased the number of permanent cures. In his opinion, nothing can compete with the complete operation performed immediately after palpation of the lump.

"There is increasing evidence that in some benign lumps, cancer develops later. The only explanation for permanent cures in cases of cancer of the breast in which the lump has been present for three years or longer is that for a certain period of that time the lump was not malignant.

"The surgeon's rule should be: 'When in doubt, perform the complete operation.' When a second lump develops in the breast following an operation for the removal of a lump and the pathological report or a restudy of the sections of the original tumor indicate definitely that it was a benign adenoma, the chances are that the second tumor is also benign. On the other hand, if one breast has been removed for cancer and a tumor develops in the other breast, the chances are that the second tumor is also malignant.

"For reasons which Bloodgood is unable to explain a discharge from the nipple antedating a tumor is less frequent in cases of malignant papillomatous cysts than in cases of benign tumors. This discharge is bloody or serous. A discharge from the nipple which is thick, granular, and grumous is associated with dilatation of the ducts beneath the nipple. Dilated ducts have no more relation to cancer than ducts that are not dilated. From his own studies, Bloodgood concludes that there is more reason to look upon pain as a forerunner of cancer than to regard a discharge from the nipple as a precancerous phenomenon. Women with a discharge from the nipple of any character should be carefully watched for the development of a tumor, but the indication for operation is the palpation of a tumor, not the discharge. It has been Bloodgood's rule not to explore the breast for discharge from the nipple only. On the other hand, when an ulcer has developed on the nipple, cancer with metastasis to the glands may be present, even when a good part of the nipple is still intact.

"The breast affected with chronic cystic mastitis in any of its forms shows no more tendency to later malignant degeneration than any other breast. If a single tumor in a breast is found on exploration to be a cyst or localized area of chronic cystic mastitis and if, when it is cut out, further evidence of chronic cystic mastitis is revealed, removal of the breast is entirely unnecessary. Removal of the breast is unnecessary also when exploration of a benign encapsulated adenoma reveals evidence of chronic cystic mastitis in the surrounding breast. With rare exceptions removal of the breast alone is illogical—it is too much for a benign lesion and not enough for a malignant lesion. If a tumor can be palpated, an exploration should be done; if not, the breast should be left alone."

The adult breast, almost exclusively in the female, is rarely the site of milk retention cysts (galactoceles). They almost invariably occur during lactation. "The contents of the cyst are at first pure milk. Later, owing to the absorption of the fluid contents, or to clinical changes, it may become thick and creamy, cheesy, or oily in character.[1] The swelling is smooth and rounded and compression of it may uncommonly cause milky fluid to exude from the nipple. The treatment is the excision under local anesthesia.

Inguinal Endometriosis.—Under rare circumstances there may be found in the inguinal region either with or without an inguinal hernia, a tender mass of variable size which has the propensity of becoming swollen and painful at the time of menstruation, or when menstruation should occur in cases of hysterectomy. The explanation of this unusual condition is thought to be that small bits of endometrium escape from the tubes into the peritoneal cavity. There they may become secondarily implanted and may grow and exhibit much the same characteristics as the normal endometrium. They may become attached to the base of the inguinal hernial sac and thus bring about the painful nodule in the groin described above.[2]

2. **Malignant Tumors.**—The malignant tumors found on the trunk—epithelioma, sarcoma, and carcinoma of the breast—belong in general to the realm of major surgery (Fig. 162).

Hertzler[3] has called attention to the importance of the early recognition of *fibrosarcomatous tumors of the skin.*

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[1] Finney, J. M. T.: Keen's Surgery, iii, 571.

[2] Christopher, Frederick: Inguinal Endometriosis, Ann. Surg., 86, 918, 1927.

[3] Hertzler, A. E.: Ann. Surg., 84, 489, 1926.

If the tumor is completely removed together with its capsule a permanent cure is assured. A tumor of this type grows slowly and metastasizes by way of the lymphatics. Its summit is covered by an attenuated skin with a reddish or pinkish color which resembles the covering of a spina bifida. In some instances the line of demarcation is sharp, suggesting the protrusion of an ulcerating mass. When the tumor begins to grow rapidly it protrudes through the surrounding skin. Sometimes hemorrhage occurs in the substance of the tumor, causing it to enlarge suddenly. If the hemorrhage is near its summit, ulceration usually soon follows. The primary tumor is spheroidal, but recurrences may be bosselated.

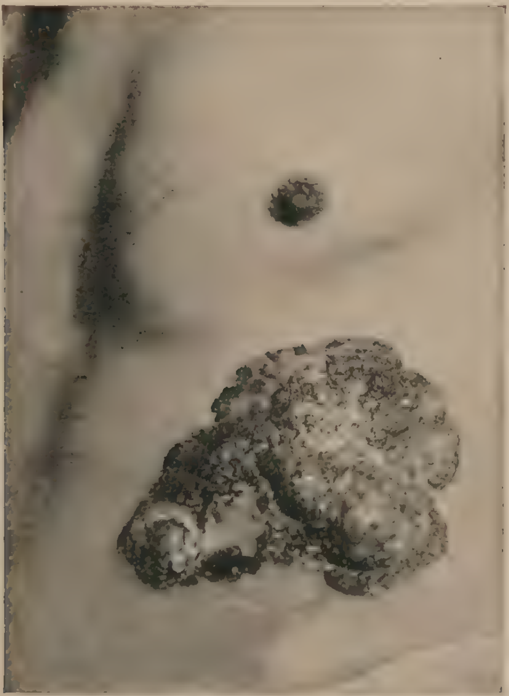

Fig. 162.—Basal-cell epithelioma of chest wall. Cured by excision by high-frequency current. (Courtesy of Dr. Edward A. Oliver.)

Hertzler finds fibrosarcomatous tumors of the skin situated most frequently on the trunk, particularly about the groins and buttocks. They are completely encapsulated except over the surface where the skin is attached to them. If they have not begun to invade the surrounding tissues they glide over the deep fascia. On palpation they are found to be firm, dense, and elastic. The cut surface shows wavy bundles more or less parallel with each other. The surface is pearly or pinkish and glistening. The cells of the tumor are spindle shaped and arranged in more or less parallel bundles. When the tumor begins to develop rapidly it invades the surrounding connective tissue. It first spreads into the skin surrounding the summit and later becomes attached to the surrounding tissues. In all metastatic areas, it retains its fibrotic character.

The peculiar relation of the skin to the surface of the tumor reveals the character of the growth at a glance. A wen is less firm, and lipomata attaching themselves to the skin cause no skin changes. Gummata lack the encapsulation and have a shorter duration. Angiomata differ in density.

The treatment is complete excision of the tumor together with its capsule well into the normal tissue.

II. CONGENITAL AND ACQUIRED DEFORMITIES OF THE TRUNK

CONGENITAL

1. Sacrococcygeal (Pilonidal) Cysts and Sinuses (Postanal Dermoid).—Pilonidal (hair nests) cysts are congenital cysts which are found at the base of the spine in the region of the sacrum. They generally contain hair and most frequently communicate with the skin by a small fistula or sinus. The opening of the sinus is generally in the midline between the tip of the coccyx and the anal canal and runs upward toward the lower end of the sacrum or coccyx. When the opening is not in the midline there is generally a well-marked depression at this point and the existing sinus or sinuses are the result of previous operations or secondary infection in the cyst. In some cases this sinus may have its orifice very close to the anus and will simulate a fistula-in-ano. In other cases the orifice will be much higher. In many cases there are multiple openings which communicate with a cyst-like cavity. Multiple openings may result from long-continued suppuration. Masson[1] reviewed 81 cases. Sixty-six cases were in males. The oldest patient was fifty-seven years and the youngest nineteen months. The average age was 30.95 years. The majority of the sinuses were probably present from birth, but have not caused appreciable symptoms until adult life. Sixty-nine of the 81 patients complained of a discharging sinus, and 29 complained also of periodic attacks of pain. Fifty-six patients had single sinuses and the remaining 25 had multiple openings. Hair was found in only 29 patients. The long continued suppuration probably destroys the hair follicles. Masson says that incision and drainage, curettage, or the use of caustics are not satisfactory, but if the cyst or sinus is thoroughly dissected out, a permanent cure with a minimum period of morbidity is obtained. Oehlecker,[1] in sacral fistulæ and abscesses, recommends a transverse elliptical incision. This author believes that at the time of puberty, small portions of skin displaced during embryological development produce small hairs which grow into the connective tissue and favor the formation of granulomata. Such collections of hairs can be seen in the microscopic picture. This author favors excision by a transverse elliptical incision. Lahey[2] has described an operation for pilonidal sinus which he believes greatly lessens the time of healing and improves the character of the resulting scar. All of the sinus tract is first removed in one block (Fig. 163). Next, a fat-lined skin flap with a broad pedicle is cut from the side of the wound which is the result of the block excision of the sinus (Fig. 164) and is transplanted into the center of the wound by suturing its internal edge to one edge of the wound, leaving the opposite edge unsutured, and with

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[1] Masson, J. C.: Surgical Clinics of North America, 737, 1925, W. B. Saunders Co.

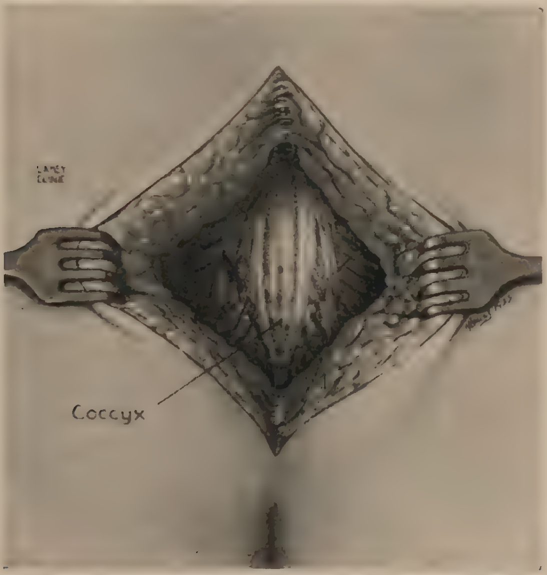

Fig. 163.—Lahey operation for pilonidal sinus. The pilonidal sinus together with all of its ramifications has been removed in one block by the excision of the entire skin area over the sinus and by the carrying of the block incision down to the sacrum and out to the glutei laterally. The sacrum covered with its aponeurotic fibers may be seen in the center of the wound and the depth of the wound and area to be filled in with granulation can be appreciated. (Lahey, F. H., Surg., Gynec., and Obst., January, 1929.)

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[1] Oehlecker, F.: Deutsche Ztschr. f. Chir., 197, 262, 1926.

[2] Lahey, Frank H.: Surg., Gynec., and Obst., 48, 109, January, 1929.

a wide defect in the remaining portion of the wound (Figs. 165, 166). Lahey states that the presence of this latter defect is of little disadvantage, since the bottom of the cavity which now results is made up of the bulging fibers of the gluteus maximus muscle, thus providing a soft yielding base for the scar which results following organization of the cavity, and does away with possibility of trauma to the scar which is produced by the solid sacrum when the scar is placed directly over that unyielding structure (Fig. 167).

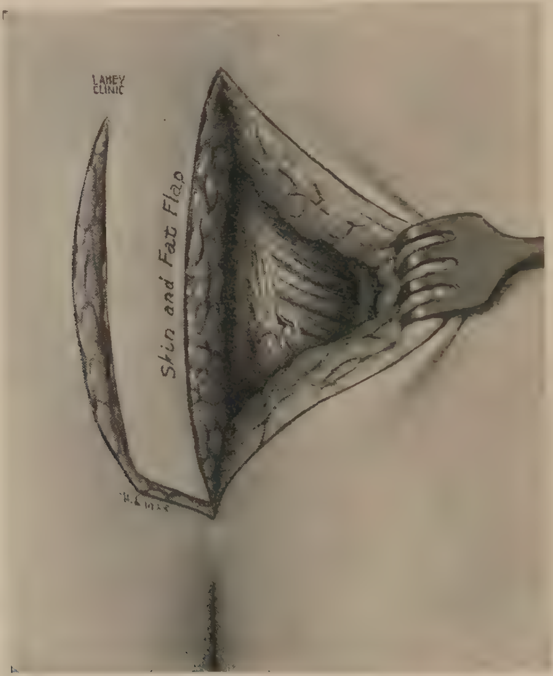

Fig. 164.—Lahey operation for pilonidal sinus. The thick, broad based pedicle of skin and subcutaneous fat has been cut from one edge of the wound preparatory to transplanting medially and has been sutured to the opposite side of the wound to fill in the deep defect left by the block removal of the pilonidal sinus and its tracts. (Lahey, F. H., Surg., Gynec., and Obst., January, 1929.)

The patient generally is unaware of the condition until a secondary infection through the fistula causes a continuous, annoying discharge, when he will seek the advice of his physician. The only cure for this condition is the complete excision of the cyst. This may be done under local anesthesia, but is much easier under general anesthesia, because the cyst may lie at considerable depth and the already difficult abscess will be still further impeded by the injection of the tissues with the local anesthetic solution. In all cases the cysts will be injected with methylene-blue solution in order that the extent and ramifications of the cyst may accurately be traced. It is important to inject the methylene blue with a blunt needle (flexible silver is best). A sharp needle may penetrate into the normal tissues and give a false impression of the location of the cyst. Where the orifice of the cyst is close to the anus, a rectal speculum should be inserted to see if any methylene-blue escapes into the rectum, in which event the diagnosis of fistula-in-ano will be made. The cyst must be completely excised, as the leaving behind of a small portion of the wall invites recurrence. The wound should be

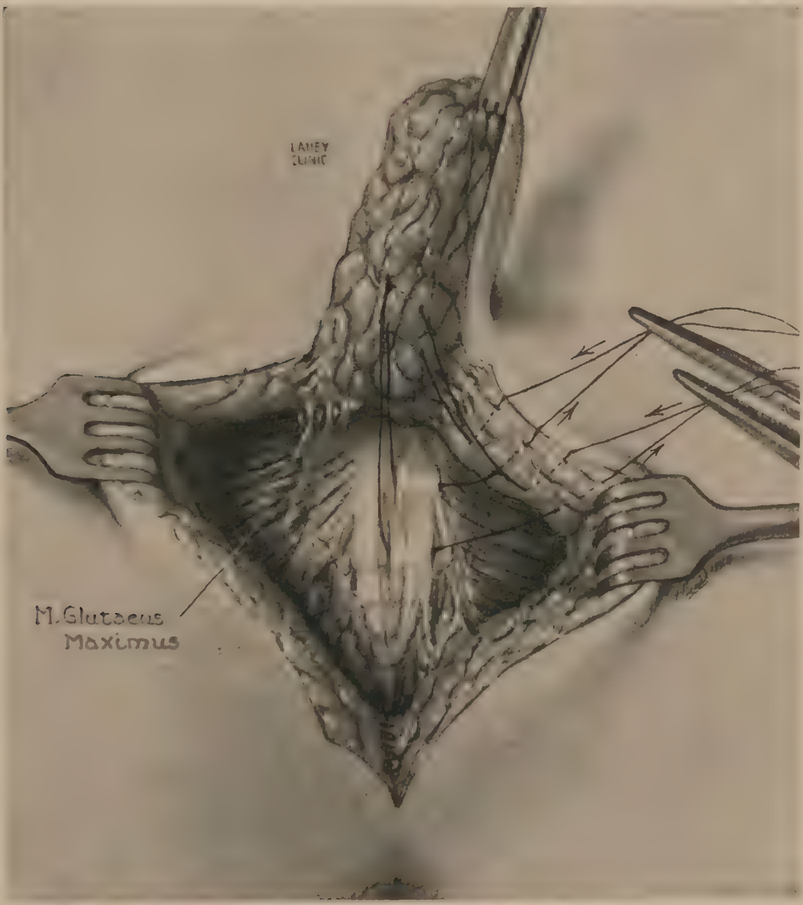

Fig. 165.—Lahey operation for pilonidal sinus. This illustration shows the method of fixing the fat-lined flap to the aponeurotic fibers of the sacrum and to the subcutaneous fat of the lateral edge of the wound, helping thus to promote early union between the flap and the deepest portion of the wound, and likewise eliminating dead spaces in which blood-clot and serum may accumulate and become infected. (Lahey, F. H., Surg., Gynec., and Obst., January, 1929.)

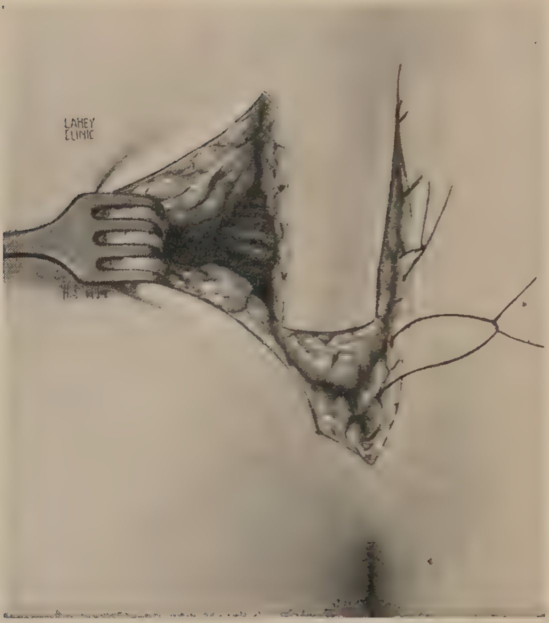
LAHEY
CLINIC

Fig. 166.—Lahey operation for pilonidal sinus. The flap is here shown fixed in its medial position by the subcutaneous sutures. (Lahey, F. H., Surg., Gynec., and Obst., January, 1929.)

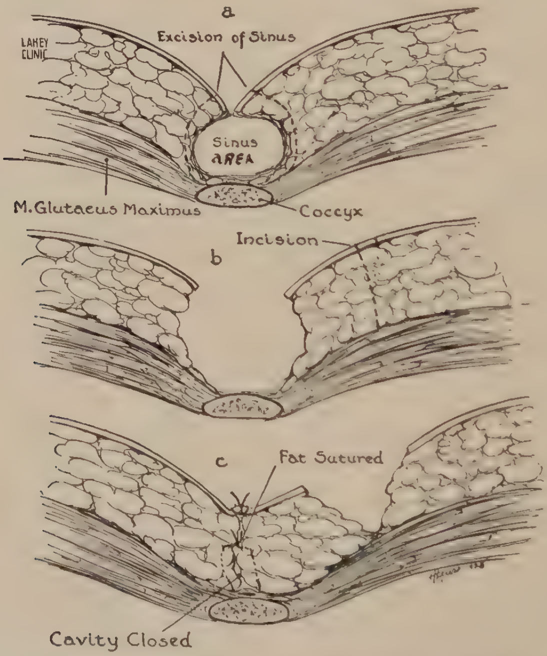
a
LAHEY
CLINIC
Excision of Sinus
Sinus
AREA
M.Glutaeus Maximus
Coccyx
Incision
b
c
Fat Sutured
Cavity Closed

Fig. 167.—Lahey operation for pilonidal sinus. Diagram illustrating the plan of the operation. (Lahey, F. H., Surg., Gynec., and Obst., January, 1929.)

left wide open and should be loosely packed with iodoform or plain gauze. It will generally be necessary to change the packing daily and each time to insert a smaller amount.

2. **Umbilical Sinus and Cyst.**—Remnants of the urachus may bring about the formation of sinuses or cysts at the umbilicus. If the bladder end of the sinus is closed, the discharge will consist only of epithelium and sebaceous material. These cases may be cured by swabbing with pure phenol or excision under local anesthesia. Where the urachus becomes closed at both ends, a cyst may result. Where the urachus is patent throughout, urine will be discharged from the sinus. In the latter 2 cases the treatment is major surgical.

3. **Congenital Deformities of the Nipple.**—(*a*) *Congenital absence of the nipple* (*aphelia*) requires no surgical treatment.

(*b*) *Multiple nipples* or *polyphelia* generally will require the excision under local anesthesia of the supernumerary nipple. It will be wise to leave the best formed nipple on the breast.

(*c*) *Retraction of nipple*, which is an acquired deformity, should never be treated as an entity in itself, but rather as an indication of a potential carcinoma or other pathology of the breast.

4. **Congenital Deformities of the Breast.**—(*a*) *Amastia* or absence of the breast and (*b*) *micromastia*, minute breast, require no surgical treatment. (*c*) *Polymastia*, or multiple breasts, will require surgical intervention. Such breast tissue as seems superfluous will be removed and an effort made to convert the remaining breast tissue into a breast of normal appearance. Plastic operations upon the breast do not belong to the realm of minor surgery.

5. **Spina bifida, meningocele,** and **myelocele** are congenital deformities originating from an incomplete closure of the vertebral arches with a varying amount of protrusion of the spinal cord and cauda equina upon the surface of the back. The condition may vary from merely a colored dimple over the spinal column to a large rounded swelling and even to an open sinus from which spinal fluid discharges. The treatment will be major surgical.

ACQUIRED

1. **Hernia.**—(*a*) *Umbilical hernia* may be congenital but generally is acquired. It is manifested by a protrusion at the umbilicus which is apparent when the infant cries. This protrusion may attain considerable size. The palpating finger on the abdominal wall will appreciate a firmly demarcated ring at the umbilicus. This ring will be as small as $\frac{1}{4}$ inch in diameter and may be considerably larger. Practically all umbilical hernias in infants will yield to mechanical or truss treatment.

For this purpose a rigid hemisphere[1] whose convex side is applied to the hernial ring after the hernia has been reduced will be useful. The hemisphere is kept in place by a band of adhesive plaster which is wider than the diameter of the hemisphere and which completely encircles the infant's body. The parents will be instructed to replace this apparatus at intervals to insure the good condition of the underlying skin. It may be necessary to persist in this type of truss for six months to a year and in some cases even longer before a cure is effected.

(*b*) *Inguinal Hernia.*—1. IN YOUNG CHILDREN.—Ingiunal hernia in young children is a rather common condition and up to the age of three years may be treated and very often cured by the use of trusses. It is of considerable importance that these trusses be properly made and properly fitted. Those with a steel band and leather pad with pressure over the inguinal ring are the best type. Once the surgeon has fitted the truss so that a continuous pressure of the pad is maintained over the ring, he must spend considerable time in instructing the parents or attendants as to the care of the truss. The truss will have to be removed daily when the child is given his bath and the skin washed with alcohol and thoroughly powdered. Should abrasions or infections arise, it will, of course, be necessary to discontinue the use of the truss temporarily. When the truss is reapplied after the bath, the infant should be lying down flat on his back and particular effort should be made to be assured that the hernia is reduced when the truss is applied.

Many parents will prefer to subject their child to an operation which carries but very low mortality and morbidity rather than to spend many months in the painstaking care that a truss requires, especially since that method is not a certain cure. The operative treatment for hernia is ordinarily considered to be a major surgical problem. In passing, however, it may be said that in a certain English clinic the treatment of hernia in infants is considered an operation of the outpatient department. Here a very simple technic has been evolved for the operation and the patients are sent home immediately after its performance.

2. IN ADULTS.—Many adults will decline operation for hernia and in patients of advanced age or with cardiovascular disease operation may be contraindicated. In these cases it will be incumbent upon the surgeon to see that his patient is properly fitted with an efficient truss. After the patient has been referred to a trussmaker in whom the surgeon has confidence, he will again be seen and inspected. The truss must

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[1] The half of a wooden ball found in a child's ten pin set will be very suitable.

have a pad of ample size to occlude the hernial ring and must have a spring of sufficient tension to maintain the pads in position. Perineal straps occasionally will be necessary. Moreover, it is extremely important to instruct the patient in the manner of putting on and adjusting the truss and the importance of being sure that the hernia is entirely reduced before the truss is applied. All trusses are best put on when the patient is lying down.

(*c*) *Femoral hernia* is a condition whose treatment requires major surgery, except in those cases in which there is a contraindication for operation. In this event trusses will be fitted in the manner described above.

(*d*) *Ventral hernia, hernias of the linea alba,* and *strangulated hernias* of all kinds require major surgery for treatment. In cases of recent incarcerated hernias it will be justifiable to employ taxis in an effort to secure reduction. It must be emphasized, however, that prolonged and rough efforts to manually reduce the hernia are productive of far more harm than surgical intervention. Taxis should never be persisted in after a few gentle efforts.

Congenital Absence of the Pectoral Muscles.—Partial or complete absence of one or both pectoralis major and minor muscles has been frequently reported.[1] The disability in the absence of pectoral muscles is extremely slight and there is no treatment.

Sacralization of the Fifth Lumbar Vertebra.—In this condition which is developmental in origin, the last lumbar vertebra loses its character as a lumbar vertebra, and either entirely or partially assumes the form of a sacral vertebra. It has been claimed that there is a relationship between sacralization of the fifth lumbar vertebra and lumbar neuralgia resembling sciatica. Schueller[2] found that sacralization was present in six of twenty-five pelves examined at the Breslau clinic. This author reports 8 cases from the Kuettner clinic in which, in spite of more or less marked union, there was never any pain. Schueller rejects the theory that pain is characteristic of sacralization and that active surgical therapy is indicated. By the term *platyspondylitis* is meant a congenital flattening of the vertebral bodies.[3]

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[1] Christopher, Frederick: Congenital Absence of the Pectoral Muscles, Jour. Bone and Joint Surg., 10, 350, April, 1928.

[2] Schueller, M. P.: Beitr. z. klin. Chir., 131, 281, 1924.

[3] Lance and Sorrell: Bull. et Mem. Soc. nat. de chir., 53, 132, 1927.

CHAPTER XV

THE MALE GENITO-URINARY ORGANS

I. INJURIES

1. Contusions of the External Genitalia.—The penis, scrotum, and testicles may be subjected to contusion by blows and by falls astride hard objects. Kicks and missiles, such as baseballs, are also liable to bring about these injuries. Contusions of the penis are particularly liable to occur by compression of that organ across the rami of the pubis in falls astride hard objects. In contusions of the penis the effusion of blood into the corpora cavernosum may be very marked and there may be considerable swelling and a great deal of pain. When accompanied by rupture of the tunica albuginea, the injury is termed *rupture of the penis.* In marked cases the swelling will be so great as to interfere with the patency of the urethra and an acute retention of urine will result. If the urethra be torn without free opening to the outside, extravasation of urine will occur, a condition not uncommonly followed by superficial gangrene. The proper treatment of contusions of the penis is bodily rest, elevation of the penis, and hot fomentations. The treatment of a coincident retention of urine will be discussed below.

Contusions involving the scrotum and its contents are particularly painful because of the extreme sensitivity of the testicle. The tunica albuginea being relatively inelastic, hemorrhage and edema inside of the testicle may cause extreme pain.[1, 2] The treatment consists of rest, elevation, and hot fomentations. In some cases contusions of the scrotum itself will cause a very marked hemorrhage into the scrotal sac which will become enormously distended with blood and the condition of hematocele result. Symptomatic treatment, as elevation and fomentations, will bring about the gradual absorption of this blood, but where the effusion is very marked it will be necessary to remove it by aspirating needle, trocar, or through a small incision. Formal operation with ligation of the bleeding vessel may be necessary. In the milder cases which are ambulatory the scrotum will be firmly compressed by means of an elastic suspensory.

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[1] Franceschi: Injuries of the Testicle. Arch. urol. de la Clin. de Necker, 1924, iv, 253.

[2] McVeigh, J. F.: Experimental Cord Crushes. Arch. Surg., 7, 573, November, 1923.

2. **Torsion of the Testes.**—This relatively rare injury consists of a torsion of the testicle on the spermatic cord so that the blood-supply of the testicle becomes interfered with. According to Young,[1] "torsion of the cord can occur by either of two mechanisms. In the first, the entire testicular mass, including testis epididymis, and tunica, rotates within the scrotum, so that the cord is twisted in its extravaginal portion. . . . In the second mechanism the torsion is intravaginal. . . . The intravaginal torsions are more frequent than extravaginal. . . . In some cases the trauma necessary to produce torsion of the cord is very slight—some have even occurred during sleep. . . . The symptoms of torsion of the cord are marked by the extreme suddenness of the onset, with severe, often sickening pain. The scrotum rapidly swells. This swelling is at first confined to the testicle, but later the scrotal tissues become edematous and the skin somewhat discolored." Wilkie[2] states that 75 per cent. of the cases occur before the age of twenty. The clinical picture may be difficult to distinguish from acute epididymitis or a strangulated hernia. According to Wilkie, the general symptoms of torsion are not so severe as those of strangulated hernia. The vomiting is not so persistent and is never fecal. There is less shock in torsion. Detorsion has been accomplished, but where this manipulation has apparently succeeded, or where a fixation operation has been done, atrophy will generally result. The correct treatment is orchidectomy and epididymectomy.

3. **Dislocation and Strangulation of the Penis.**—Violent traumatism of the penis, particularly when erect, may cause the subcutaneous dislocation of that organ to a position under the skin of the abdomen or the thigh. Urinary infiltration will take place even if the urethra is not injured (Young). Restoration of position may be difficult without extensive incision of the integument. Strangulation of the penis occurs in cases where metal rings have been passed over the penis, or it has been constricted by rubber bands or cords. In this case there is marked edema and the disturbance of the circulation may be so marked as to cause gangrene and amputation will be necessary. In most cases, however, the constricting agent may be removed early enough to permit recovery.

4. **Wounds of the Penis.**—The penis may be wounded by knives or by crushing violence. The corpora cavernosa are most frequently involved with knife wounds. The hemorrhage may be very alarming, especially if the penis is erect at the time of the injury, and will require

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[1] Young, Hugh H.: Practice of Urology, W. B. Saunders Co., 1926, p. 164.

[2] Wilkie, H. T.: Amer. Jour. Surg., 14, 31, July, 1927.

most careful hemostasis together with efforts to actively reapproximate the wound edges. Severe traumatism of the erect penis may bring about a laceration of the substance of the corpus cavernosa, known as "fracture" of the penis. The edema may be so marked as to cause dysuria or acute retention. The usual treatment is elevation with hot fomentations.

In certain cases of traumatism to the erect penis the frenum may be torn and a severe hemorrhage from the frenular artery result. This condition will practically always require either clamp or ligature or the passing of a deep stitch to include the frenular artery. In all cases of wounds or contusion of the penis it will be advisable to give large doses of sodium bromide (60 to 80 grains a day) to control erection.

5. **Foreign Bodies.**—*In the Penis and Urethra.*—The introduction of foreign bodies into the urethra is a rather common occurrence, particularly in females. All manner of such foreign bodies have been used: pins, nails, hairpins, pieces of wire, etc., have been introduced for various distances. One of these may be left in protruding from the meatus and the patient comes to the doctor because the swelling will be so marked that he will be unable to extract it. It may be palpated in the penile urethra or seen by the endoscope. General anesthesia may be necessary to remove it. Small foreign bodies loose in the urethra may be removed with the urethroscope and forceps. Cases in which pins have been introduced will be treated by reversing the direction of the pins after the method described in the section on Foreign Bodies. Where the foreign bodies have actually entered the bladder it will be necessary to refer the patient to the urologist for cystoscopy. In many cases the cystoscopist will be able to remove the foreign body through the cystoscope. In others a cystotomy will be necessary. Foreign bodies which have been allowed to remain in the bladder for a long period of time will become encrusted with salty deposits or in some cases will ulcerate through the bladder wall and cause an abscess formation in the peritoneal cavity or in the perineum.

6. **Rupture of the Urethra and Bladder.**—(*a*) *Rupture of the Urethra.*—Ruptures of the urethra generally occur in the bulbous portion following falls astride hard objects. The patient will be found having a small amount of hemorrhage from the urinary meatus and with marked swelling and some ecchymosis at the site of the injury. In a very short time the swelling will become very much more marked due to the extravasation of urine. If these cases be unrecognized or neglected the results may be extremely dangerous. Untreated extravasation of urine will cause a necrosis and sloughing of all the parts invaded by the

urine. This condition is a major surgical emergency and requires very prompt treatment. The details of this surgical treatment do not belong to the realm of minor surgery.

(*b*) *Rupture of Bladder.*—The bladder may become ruptured in consequence to crushing violence across the abdomen, or because of unskilful instrumentation in the bladder. The condition is recognized because of absence of urination, the history of the traumatism, and the negative results from catheterization. The treatment is major surgical.

7. **Acute Retention of Urine.**—Retention of urine may come about from various causes, including the following:

(*a*) Hypertrophy of the prostate.
(*b*) Stricture of the urethra.
(*c*) Reflex disturbance following operation.
(*d*) Wounds in the penis.
(*e*) Acute infections.

In those cases of reflex disturbance following operation relief is often obtained by the giving of an enema, the application of hot fomentations to the external genitalia, and permitting the patient to hear the sound of running water or even in some cases permitting the patient to stand up beside the bed. Catheterization should never be employed unless all other measures have been tried without success. If catheterization becomes necessary, it should never be done by an orderly, but always by a doctor, who has been properly instructed.

In patients having an acute retention of urine, of a mechanical origin, it will be necessary to attempt some type of catheterization. In hypertrophy of the prostate and in acute infections, particularly in gonorrheal (where symptomatic treatment has been ineffectual), where the lumen of the urethra is not impaired, a first effort should be made with a No. 18 rubber catheter. It is quite probable that in cases of this type a large catheter will be more easily passed than a small one, because the latter is supposed to excite a more forcible constriction of the urethra.

Technic of Catheterization.—Before performing catheterization in the male the surgeon will first scrupulously clean the head of the penis with soap and water and with bichloride of mercury solution. The latter should not be stronger than 1 : 1000. As the last step in the cleansing the lips of the external meatus must be spread apart and the first portion of the urethra irrigated with the bichloride solution. The hands of the surgeon either should be sterilized by scrubbing and alcohol or should be incased in sterile rubber gloves. After the penis has been cleansed and sterilized with bichloride it should be laid upon a sterile sheet or gauze sponge. The catheter is then grasped about its middle portion and the end which is first to enter the penis is thoroughly anointed with sterile albolene or sterile lubricating jelly (Fig. 168). The surgeon's other hand now grasps the head of the penis immediately behind the glans and exerts an upward traction upon the penis. The catheter is then passed slowly and gently into the urethra. Too forcible manipulation will only excite an obstructive contraction of the urethra. One of the chief factors in the successful accomplishment of the catheterization is the marked degree of traction upon the penis. This maneuver straightens out the urethra and more readily permits the passage of the catheter. When the catheter has entered the bladder and the urine begins to flow the penis is lowered and the catheter placed in a proper receptacle. In cases where a soft-rubber catheter will not pass, it will be advisable to use a Mercier silk catheter, being careful to have the tip point upward. In cases where this fails a curved metal catheter will be used. The same antiseptic precautions are used which were described above and the penis is drawn up upon the shaft of the metal catheter. The shaft of the metal catheter is held immediately

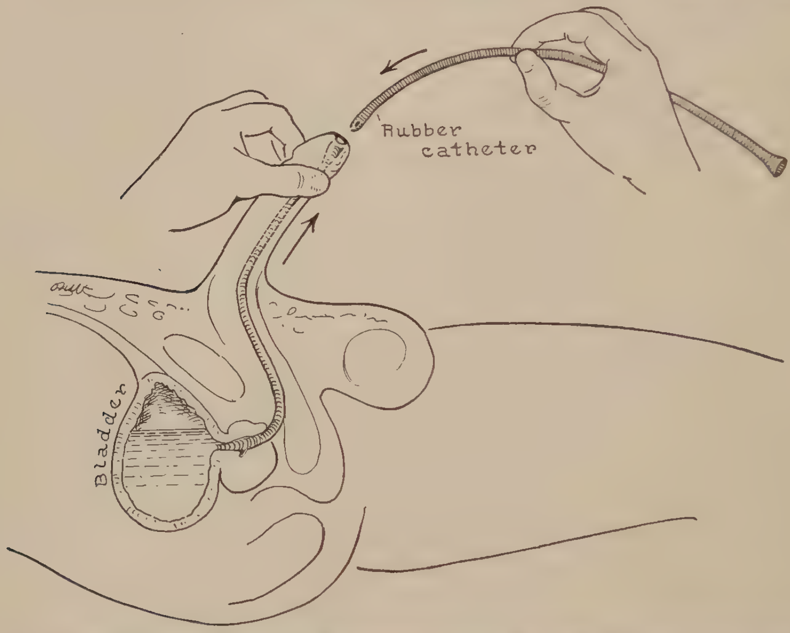

Fig. 168.—Method of catheterization with soft-rubber catheter. The hands and the head of the penis are thoroughly cleansed and washed with an antiseptic solution. Preferably, rubber gloves are worn. The catheter is grasped as far back as possible. The penis is drawn up tightly so as to straighten out the urethra as much as possible. The catheter is passed into the urethra until the urine begins to flow.

above and parallel to the abdominal wall, and firm upward traction is made upon the head of the penis. With continued traction upon the penis the catheter is gently advanced. The distal end is elevated and slowly made to describe a semicircle from the abdomen to the space between the legs (Fig. 169). The proximal end will then have entered the bulbous urethra and finally the bladder. Occasionally it will be necessary to guide the tip of the catheter by placing the hand beneath the perineum behind the scrotum. It is needless to say that extreme gentleness is absolutely necessary in all catheterizations. Where obstruction is met with, no force should be used, but rather further gentle trials at a slightly different angle. (See page 336 for a treatment of post-operative retention.)

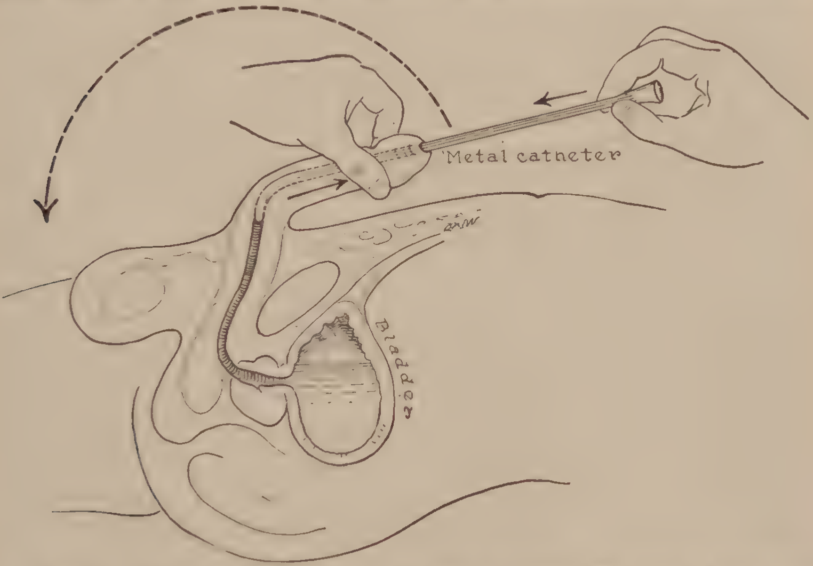

Fig. 169.—Method of catheterization with metal catheter. The penis is held parallel to the surface of the body and strong upward traction is made on it as the catheter is passed. When the curved tip of the catheter has passed the base of the penis, the penis and catheter are swung over an angle of 180 degrees as tip enters the bladder. It is occasionally necessary to guide the tip of the catheter by placing the hand against the perineum.

In cases of acute retention of urine caused by stricture of the urethra it will be impossible to pass the ordinary catheter. In this case it will be necessary to resort to filiform bougies filled with threaded caps to be attached to a follow-up catheter. The passage of filiform bougies requires considerable skill, patience, and gentleness. Where the urethra is very sensitive it will be advisable to instill 5 or 10 c.c. of local anesthetic solution. For this purpose 0.5 per cent. cocaine with 1 : 1000 epinephrine may be used. More preferable, however, are 1 per cent. procaine and 0.5 per cent. alypin. The first filiform bougie is passed with traction placed upon the penis until it either enters the bladder or meets with obstruction. In the event of obstruction another filiform bougie is passed in an attempt to find the minute stenosed opening of the stricture. In case this also meets with obstruction, further bougies are passed until the urethra may contain six or seven, or more. By patient, alternate manipulation of the different bougies, finally one will be made to enter the stricture and will be felt to pass on into the bladder. When this occurs the follow-up catheter will be screwed on the successful bougie and the other, unused, bougies will be withdrawn from the urethra. With the filiform bougie as a guide the follow-up catheter will now be inserted into the bladder. At the point where the expanding tip of the follow-up catheter dilates the stricture considerable resistance will be encountered. By steady, gentle, and occasionally forceful pressure this resistance will be overcome. The tip of the filiform will be coiled up in the bladder when the catheter has finally been passed. It is important that the screw connection of the filiform bougie and the follow-up catheter be tight, and that the filiform itself be in good condition or else there is considerable danger that the filiform or parts of it will be left in the bladder after the withdrawal of the catheter.

Following such a catheterization for *stricture of the urethra* it will be necessary to treat the stricture either by the passage of gradually enlarging sounds or by an internal urethrotomy. The latter procedure is best intrusted to the hands of a urologist. Nelken[1] advises against internal urethrotomy because of the likelihood of deformity after this procedure. External urethrotomy is indicated if instrumentation is followed by excessive bleeding or septic chills. In the event that catheterization has been unsuccessful *trocar puncture of the bladder* or a suprapubic cystotomy will be necessary. Where the trocar is used, the bladder is distended, and the skin and the subcutaneous fascia of the suprapubic region are well infiltrated with $\frac{1}{2}$ or 1 per cent. procaine. A $\frac{1}{4}$-inch incision is made in the midline immediately above the symphysis pubis. The trocar is carefully forced down through this incision into the bladder. *Suprapubic cystotomy* is generally best performed under local anesthesia, but general anesthesia, preferably ethylene, will some time be the choice. The Trendelenburg position with the knees spread apart is the best position. A $1\frac{1}{2}$- to 2-inch incision is made in the midline. A longitudinal incision is made through the deep fascia and the two recti muscles spread apart by blunt dissection. Previous to operation the bladder will, if possible, have been distended with sterile fluid or air. The finger will now dissect away the fat and areolar tissue above the symphysis and expose the bladder. The latter may readily be recognized by the wavy musculature, the soft fluctuant sensation, and the large veins upon its surface. The bladder should not be separated from the symphysis. The bladder is now steadied by two "Allis" forceps or by two silk traction sutures, and a scalpel is plunged through its wall. For permanent drainage a de Pezzer self-retaining mushroom catheter is placed in the opening. It is held in place in the bladder by the bulbous enlargement. A suture may be placed in the bladder to reduce the size of the opening if necessary. If an ordinary rubber tube is used the suture may be passed through it to hold it in place. Young advises a suture fastening the tube to the skin. The wound is drained at the lower angle, and the wound is approximated.

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[1] Nelken, A.: New Orleans Med. and Surg. Jour., 1925, 67, 439.

8. **Priapism.**—In this condition the penis is maintained in a state of more or less continuous erection. It is caused by an injury or disease to the spinal cord, or by vesical calculus, or certain injuries of the penis. In the neurological cases the treatment will be symptomatic and most often is ineffectual.

9. **Burns of the Genitalia.**—In ordinary burns of thermal origin involving the genitalia the same rules as laid down in the section on Treatment of Burns are followed. The genitalia are particularly subject to chemical burns produced by mustard gas. These very irritating burns are best treated by early mechanical removal of the mustard, and by bland ointments, as vaseline and zinc oxide ointment.

10. **Hematuria** should never be treated as an ailment in itself, but as a symptom of more serious trouble. The causes of hematuria are numerous and its diagnosis and treatment do not belong to the realm of minor surgery.

II. INFECTIONS

1. **Paraphimosis** is a term applied to an unreducible retraction of a narrow, inflamed prepuce. In this condition the inflamed foreskin has been retracted and cannot be replaced. The longer the condition exists, the greater will be the swelling, not only of the prepuce but of the constricted glans penis. In early cases efforts should be made to replace the foreskin by gentle pressure applied to all parts of the circumference of the foreskin and exerted distally (Fig. 170). If this steady pressure is maintained for a few minutes, it is occasionally possible to replace the retracted prepuce. In many cases, however, where the prepuce is too tight or where the condition has persisted for too long a time, surgical intervention is necessary. When there is a considerable

degree of inflammation it will be advisable to do a "dorsal slit." As a preliminary to this procedure the dorsal surface of the foreskin is infiltrated with $\frac{1}{2}$ of 1 per cent. novocaine solution. With a sharp knife the upper constricted portion of the retracted foreskin is then cut and replacement is then possible. When this wound has healed and the inflammation has entirely subsided a circumcision will generally be indicated. In those cases where the degree of inflammation is slight it is occasionally possible to do a circumcision primarily and thus to completely relieve the condition at one sitting.

2. **Balanitis** is the term applied to an inflammation of the glans penis and is generally found in cases of phimosis, where it is difficult to retract the prepuce and pathogenic organisms propagate beneath it. *Balanoposthitis* is an inflammation of the lining of the preputial cavity, that is, of the prepuce and glans prepuce. It is a common complication of gonorrhea. A symptomatic treatment for acute cases will be hot boric fomentations, but the only treatment that offers certain success is circumcision. Circumcision is best performed after the inflammation has subsided.

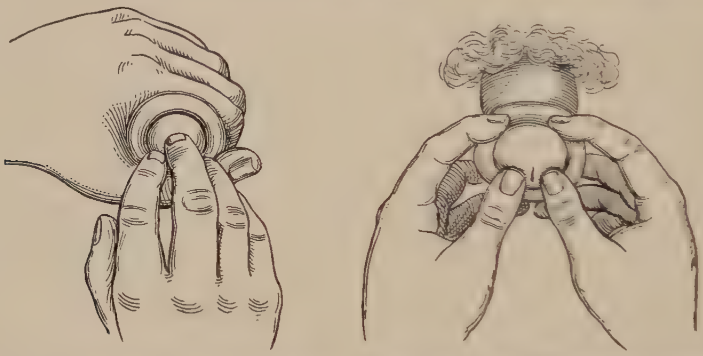

Fig. 170.—Reduction of a paraphimosis. (From Moorhead, "Traumatic Surgery.")

3. **Abscess.**—Cutaneous abscesses may occur on the shaft of the penis. Abscesses of the body of the penis also may occur as the result of gonorrheal infections. When fluctuation is apparent these are treated by incision and drainage, with particular attention directed toward hemostasis.

4. **Venereal Diseases.**—The treatment of venereal disease does not come within the scope of minor surgery, except for such complications as require minor surgical procedures for their treatment. Stricture of the urethra is most commonly caused by a pre-existing gonorrheal infection. The treatment of stricture has been described in a preceding paragraph on Catheterization. Acute gonorrheal urethritis and cystitis may cause

a functional retention of urine, the treatment of which has been described under Catheterization.

Abscess of the prostate gland will occasionally follow gonorrheal infection. The existence of this condition is apparent because of extreme pain in the region of the perineum, difficulty in urination and defecation, increase in temperature, and leukocytosis. Uncommonly, the abscess of the prostate will cause no swelling in the perineum and the rectal examination which ordinarily will demonstrate a tender mass will be negative. The diagnosis in these cases will be extremely difficult, if at all possible. The treatment of frank prostatic abscess with a median bulge in the perineum is to place the patient in the lithotomy position and to make an oblique incision, starting in the median line and extending backward and outward for a distance of about 4 to 6 cm.; division of fat and fascia; insertion of the finger to open up the space bounded by the transversus perinei and triangular ligament in front, the central tendon and recto-urethralis internally, and the levator ani posteriorly (Young), cautiously deepening the inner portions by blunt dissection until the abscess cavity is entered. A sound is passed into the urethra for guidance in avoiding the urethra. Drainage with gauze or soft-rubber tubing will be indicated and hot fomentations instituted to relieve the pain and to accelerate the discharge.

Acute epididymitis is a common sequel of gonorrheal infection. Of 3606 cases of epididymitis treated at the Urological Service of Bellevue Hospital, New York, 3000 had resulted from neisserian infection, 280 were tuberculous, and 326 were of non-specific origin (Campbell[1]). According to Rolnick,[2] "Within a few hours after the bacteria have reached the tail of the epididymis, they penetrate between the epithelium, involve the wall, and extend to the interstitial and peritubular tissues, there to set up the inflammatory process." It is manifested by excruciating pain in the epididymis, swelling, and marked tenderness. The patient will have considerable elevation of fever and his sufferings will be very marked. The treatment of this condition requires rest in bed, elevation, and immobilization of the scrotum by an adhesive suspensory, copious, continuous hot boric fomentations and catharsis (Figs. 171–174). The use of magnesium sulphate solution for hot fomentations has been advocated by some in these cases. Campbell[3] recommends the ice-bag for pain. This writer says that 1 in 15 of the gonorrheal cases, and one in 4 of the non-gonorrheal cases will require opera-

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[1] Campbell, M. F.: Ann. Surg., 1928, 88, 98.

[2] Rolnick, H. C.: Surg., Gynec., and Obstet., 47, 806, December, 1928.

[3] Campbell, M. F.: Jour. Amer. Med. Assoc., 89, 2108, December 17, 1927.

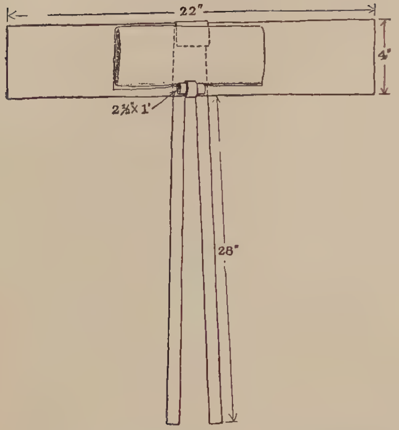

Fig. 171.—Adhesive scrotal suspensory. Note small perineal roller bandage. (Campbell, M. F., Jour. Amer. Med. Assoc., December 17, 1927.)

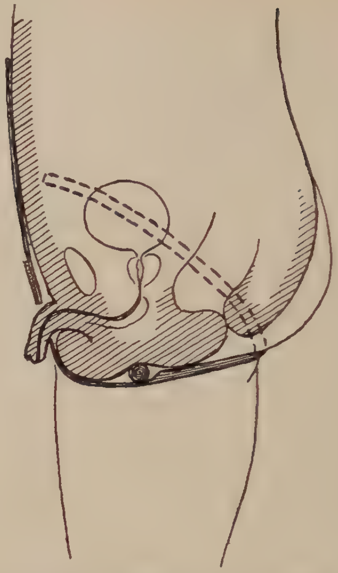

Fig. 172.—Application of small roller bandage high in scrotoperineal angle to prevent scrotal contents from slipping down into the perineum. (Campbell, M. F., Jour. Amer. Med. Assoc., December 17, 1927.)

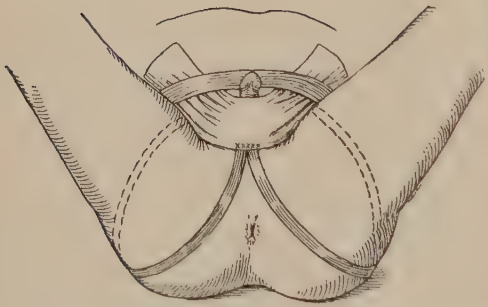

Fig. 173.—Perineal aspect of scrotal suspensory; small crosses indicate position of roller bandage high in scrotoperineal angle. (Campbell, M. F., Jour. Amer. Med. Assoc., December 17, 1927.)

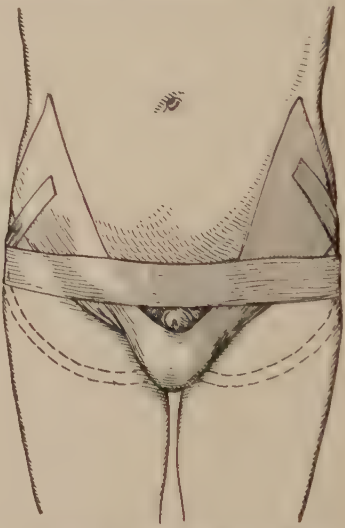

Fig. 174.—Properly applied adhesive scrotal suspensory with suprapubic cross strapping reinforcing support to the degree of complete immobilization. (Campbell, M. F., Jour. Amer. Med. Assoc., December 17, 1927.)

tion. In Campbell's cases epididymotomy was done 200 times, and epididymectomy 74 times. In epididymotomy a single clean incision is made into the tail of the epididymis without incision of the tunica vaginalis (Rolnick). The relief from the pain is immediate. It is thought by some that early drainage tends to lessen tubular destruction. A chronic non-specific epididymitis under the clinical picture of tuberculosis has been described.[1]

Gumma of the testicle is a manifestation of tertiary syphilis and is evidenced by a hard enlargement of the testicle, with a history of lues and positive blood Wassermann. The treatment will be antiluetic; salvarsan, mercury, and particularly potassium iodide will cause a rapid subsidence of the swollen testicle.

Orchitis or inflammation of the testicle is accompanied by pain and swelling of that organ and may be due to gonorrhea, syphilis, or tuberculosis. The treatment will be directed toward the causal infection. Incision and drainage will rarely if ever be necessary. Orchitis is a common complication of mumps, occurring in 15 to 30 per cent. of the cases in young men and boys.[2] It develops at the end of the first or early in the second week. Atrophy of the testicle is said to occur in about 53 per cent. of the cases. Mumps of the testes without parotitis has been reported.[3]

5. **Elephantiasis of the genitalia,** particularly the scrotum, may occur in filariasis. The treatment of this condition will be directed toward the extermination of the Filariæ, although there is no specific treatment. In certain cases where there is tremendous enlargement of the scrotum amputation will be necessary. This operation is so extensive as best to be included in major surgery.

6. **Tuberculosis of the Genito-urinary Tract.**—The epididymis, vesicles, prostate, and the kidney are the most frequent sites of tuberculous infection. It is secondary to a focus elsewhere in the body. Tuberculosis of the epididymis is manifested by swelling and hardness of the epididymis and by the finding of tubercle bacilli in the urine. Barney and Colby[4] believe that genital tuberculosis in the male is merely a manifestation of a generalized tuberculous infection, that the primary genital focus is the epididymis, and that the tubercle bacilli reach the genital organs by way of the blood-stream. The treatment will be systemic, directed toward the irradication of the tubercle bacilli and

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[1] Biebel, Max: Zentralbl. f. Chir., 54, 2337, September 10, 1927.

[2] Wollstein, M.: Cecil's Text-book of Medicine, W. B. Saunders Co., 1927, p. 290.

[3] Danielson, R. W.: Jour. Amer. Med. Assoc., 89, 2041, December 10, 1927.

[4] Barney, J. D., and Colby, F. K.: Jour. Urol., 1928, 19, 657.

local when abscess formation takes place, when incision and drainage is indicated. Epididymectomy is the choice of many surgeons. Barney[1] emphasizes that in epididymectomy it is important to divide the vas deferens well beyond the internal inguinal ring over the bony pelvis to avoid the formation of fistula. The conclusions of Bumpus and Thompson[2] are:

1. Dysuria is a symptom of urinary tuberculosis and does not occur when the disease is confined to the genital tract.
2. The presence of the bacilli of tuberculosis in the urine indicates renal involvement.
3. Unless the urine is microscopically negative cystoscopic examination should be made in all cases of chronic tuberculous epididymitis.
4. Satisfactory late results may be expected in more than 60 per cent. of cases.
5. It may be expected that epididymectomy will be followed by involvement of the opposite epididymis in 39 per cent. of cases.
6. Usually involvement of the opposite side will occur within one year of the epididymectomy.
7. There is a 7 per cent. chance of the development of renal tuberculosis after operation.
8. Conservative treatment—epididymectomy and heliotherapy—offers a better prognosis than more radical measures.

The first symptoms which will attract attention to tuberculosis of the kidney will be those of a cystitis. Frequency of urination and pus in the urine should never be considered as coming solely from the bladder without a most painstaking urological examination to rule out the kidneys themselves. A careful search for tubercle bacilli must be made in the urine and if none be found, it will be wise to inoculate a guinea-pig and see if this animal dies of tuberculosis. More than one guinea-pig may have to be injected. The treatment of tuberculosis of the kidney is a major surgical problem and the cystitis which is a sequel to it will not be remedied until the source of infection from higher up in the urinary tract has been removed.

Diphtheria infection of the scrotal contents has been described by Martin.[3]

Granuloma inguinale is generally found in the tropics but cases, especially in negroes, are by no means uncommon in the United States.

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[1] Barney, J. D.: New England Jour. Med., 1928, 198, 442.

[2] Bumpus, H. C., Jr., and Thompson, G. J.: Surg., Gynec., and Obstet., 47, 791, December, 1928.

[3] Martin, C.: Jour. Amer. Med. Assoc., 90, 1115, April 7, 1928.

This disease is specific but authorities disagree as to the exact nature of the organism. An excellent description of the pathology is furnished us by Young and Davis.[1] "Pathologically, the lesion caused is a proliferating, sclerosing, but no necrotizing, granuloma. It usually follows venereal exposure. In males, it usually begins on the penis and especially in the coronary sulcus, but may commence on the shaft, at the base, on the scrotum, or even in the groins. In females, the primary location is often in the perineum or vulva. At first there is a firm papule, which grows larger, and finally excoriates on the surface. This ulceration continues to spread and flourishes best where the surface is damp, hence the preference for the vulvar, preputial, inguinal, and anal regions. Lumps or papules, similar to the primary lesion, may appear beyond the advancing borders of the ulcers. Certain areas may become quiescent and epithelize from bits of epithelium or interpapillary processes left behind at the time of ulceration. In such areas the surface is rough and irregular, due to the alternation of sclerosis and infiltrated granulation tissue, and the epithelium is smooth, thin, glistening, and often devoid of pigment. Where the lesion is active and ulceration present, the edge and base are markedly proliferated, masses of firm, infiltrated granulation tissue projecting above the surface and rolling out over the edges. On the glans and prepuce, this marked proliferation may simulate epithelioma. The surface is irregular, and shows only moderate tendency to become purulent; in fact, on exposed areas, like the abdomen or thigh, the surface may be almost dry." In the treatment of this condition antimony is a specific. A 1 per cent. boiled solution of tartar emetic (sodium and potassium antimony tartrate is given intravenously. The first dose should be 0.01 to 0.02 gm. Thereafter twelve to fifteen doses are given on alternate days in increasing doses up to 0.12 or 0.15 gm. Abel of the Johns Hopkins University has prepared two antimonials—sodium antimony thioglycollate and a new synthetic compound, the triamide of thioglycollic acid. Antimony is a specific for this disease.[2]

III. TUMORS

1. **Benign.**—*(a) Warts (verrucæ)* and *papillomata* occur chiefly in individuals with phimosis or long foreskins which are not often retracted for cleansing. Cleanly habits or a circumcision are good prophylactic measures against these lesions. These benign neoplasms may

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[1] Young, Hugh H., and Davis, David M.: Practice of Urology, W. B. Saunders Co., 1926, p. 192.

[2] McGlinn, J. A.: Amer. Jour. Obst. and Gyn., 1926, 12, 665.

be removed by fulguration or by excision. In the case of papillomata excision is somewhat preferable because it permits the histological examination which is particularly desirable in the case of papillomata to rule out carcinomata.

(*b*) *Sebaceous cysts* or wens occur singly or multiply. They are treated by excision under local anesthesia.

(*c*) *Venous varices* and other vascular tumors may occur. Their removal may be more difficult and will generally require a general anesthetic.

2. **Malignant.**—Epithelioma, teratoma, and sarcoma of the external genitalia require major surgery for their treatment.

IV. CONGENITAL AND ACQUIRED DEFORMITIES

The Prepuce.—(*a*) *Phimosis.*—In the condition of phimosis the distal portion of the prepuce is so narrow and constricted that it will be difficult or impossible to retract the foreskin over the glans penis. Many individuals having this condition will suffer no discomfort and will be able to urinate satisfactorily. In most cases, however, the stream of urine will be interfered with and there will be a burning irritation of the glans beneath the prepuce because of the continual presence of urine. In mild cases of phimosis in young infants divulsion of the narrowed outlet with an artery clamp on one or more occasions will frequently effect a cure. In marked cases circumcision or dorsal slit will be advised.

(*b*) *Adherent Prepuce.*—In young infants firm adhesions may occur between the prepuce and the glans penis and although the foreskin is not tight it will be difficult to retract it. These cases are very simply treated by careful cleansing of the foreskin with soap and water and washing with boric solution and then carefully but forcibly retracting the foreskin with the aid of gauze pledgets. This procedure often will have to be supplemented by stripping free the adhesions with the sharp end of the probe. A white sebaceous material will be found beneath the adherent prepuce and this will be removed as the adhesions are separated. After careful washing the foreskin is replaced. The parent of the child is instructed to retract the foreskin daily during the child's bath and after retraction to replace it immediately. The latter advice is important, as was shown by one case where the mother yielded to the child's protests and left the foreskin retracted and a paraphimosis resulted which necessitated immediate circumcision.

(*c*) *Redundant Prepuce.*—The exact definition of redundant prepuce will be difficult. Many individuals with extreme degree of redundancy have no symptoms whatsoever, and the mere presence of a rather long foreskin is not in itself an indication for circumcision. In some cases, however, where there is redundancy of the foreskin there will be some interference with the urinary stream and because of the general failure of extreme cleanliness of the under side of the foreskin a mild balanitis or irritation will result. This condition has been thought in some cases to give rise to masturbation in young children. Circumcision will be advised in all cases where there is irritation beneath the foreskin or where there is interference with the urinary stream. The advice to have circumcision performed as a routine treatment of masturbation does not seem logical unless there be present definite signs of cutaneous irritation beneath the prepuce. Likewise, the advice to have circumcision done in cases of enuresis seems to have but little logical basis, save as a dramatic psychological procedure and on this basis occasionally has been successful.

(*d*) *Preputial Calculi.*—Occasionally the sebaceous material included beneath an adherent prepuce will be calcified. Its removal will be similar to the procedures described in freeing adhesions of the prepuce.

(*e*) *Circumcision* (*Ablation, Posthetomy*).—The operation of circumcision has generally been accorded far less respect than the usual difficulties of the procedure involve. Parents with the idea of doing a favor to struggling young doctors will often give them what they believe to be the most simple operation in surgery, little realizing that it requires some judgment and not a little dexterity for its proper completion. Of recent years it has been the practice of many obstetricians to perform circumcision routinely on all newborn babes, and this policy cannot be too strongly endorsed. The operation may be done quickly and without anesthesia in the newborn babe and is permanently forgotten by the patient and his parents. How many parents have bewailed the fact that it is not done at birth when the, to them, momentous question of circumcision comes up in the child five years old.

The first question to be decided in the operation of circumcision is the choice of anesthesia. In infants up to one or two months no anesthetic whatever will be required. Older than six months and up to thirteen or fourteen years general anesthesia will be necessary. In the small babies a few drops of ether will suffice to make the child hold still and to remove his pain sensations. In the older children the anesthetic makes the procedure a more formal one and in some cases will require hospitalization. Above the age of thirteen and fourteen circumcision will be performed under local anesthesia, unless the patient himself requests a general anesthesia. The operation is more difficult under local anesthetic because of the distention of the prepuce with the anesthetic solution and the likelihood of inaccurate amputation of the redundant skin. Where local anesthesia is elected, a 1 or 2 per cent. solution of procain will be employed. This may be injected by the infiltration method in the operative field or the "block" method may be used. Of the latter procedure Young and Davis[1] say, "using a 2 per cent. procain, a circle of injections is made along the base of the penis in the subcutaneous tissues. About 1 c.c. of the solution is also injected beneath Buck's fascia on each side."

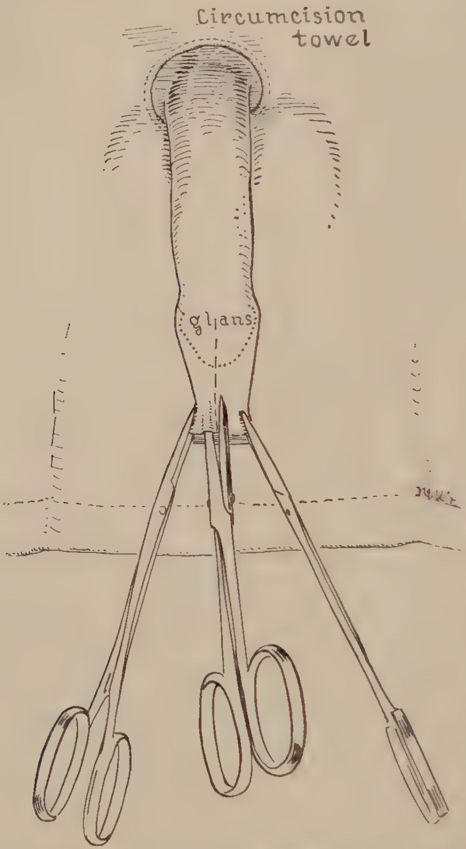

Fig. 175.—Circumcision. The penis and foreskin have been prepared with an antiseptic solution and are drawn through the hole in a "circumcision" towel. The redundant foreskin is grasped by two mosquito forceps and is cut with scissors anteriorly and posteriorly.

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[1] Young, H. H., and Davis, D. H.: Young's Practice of Urology, W. B. Saunders Co., 1926, p. 645.

The cleansing of the prepuce, glans, penis, and scrotum should carefully be carried out with green soap and water and followed by a thorough application of alcohol or of *mercurochrome acetone solution.* According to Scott and Hill,[1] the latter solution is prepared by dissolving 2 grams of mercurochrome in 35 c.c. of distilled water, to which solution are added 55 c.c. of 95 per cent. ethyl alcohol and 10 c.c. of acetone. The field of operation is then carefully draped with sterile linen. For this purpose a "circumcision" towel is admirable. This consists of a towel in the center of which a small hole has been sewn, through which the penis may be drawn. Where possible it may be desirable to have an assistant to help in the circumcision, but, unfortunately, this is generally not the case. Many methods have been advocated for the actual operation, but a serviceable method is as follows:

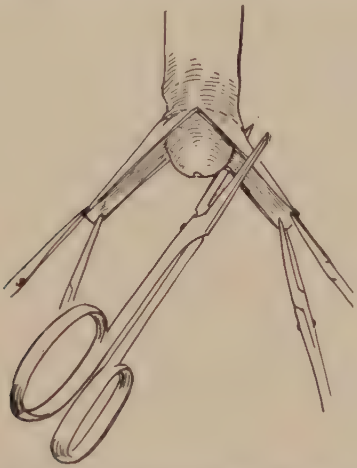

Fig. 176.—The anterior and posterior incisions in the foreskin have been made, and the lateral flaps are being trimmed off.

The lateral margins of the redundant prepuce are grasped by two mosquito forceps and the foreskin put on some slight tension. A dorsal slit is now made either with scissors or with a scalpel upon a grooved director (Fig. 175). Extreme care must be taken that the lower blade of the scissors does not enter the urinary meatus, a serious accident which occasionally has happened. If too great a tension be applied to the foreskin the dorsal incision will be made too long and it will be well from time to time to relax the tension on the foreskin and retract it, in order to determine just how far proximally the incision has been made. When this incision has been made of proper length, that is, so that about

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[1] Scott and Hill: Jour. Urol., July, 1925.

0.5 cm. remains above the coronary sulcus, a similar incision is made posteriorly in the median raphé of the foreskin down to the frenum. It is generally inadvisable to cut the frenum. The two lateral flaps thus made will now be cut across at the base, so that a straight, continuous circle circumscribes the penis at the region of the glans (Fig. 176). A border of the internal flap of the foreskin must be allowed to remain of ample width to permit suturing. This generally should be $\frac{1}{8}$ to $\frac{3}{16}$ inch. Some authorities believe that at the completion of the operation enough foreskin should remain to cover the corona. Young says that "the advantage of this conservative operation is that the normal sensitiveness and lubricating secretions of the preputial skin are retained, both of which are said to be much appreciated in later life." This, however, seems unnecessary. It is particularly important at this point to secure complete and accurate hemostasis. The artery of the frenum should be clamped and tied with very fine catgut and one should not rely on the sutures which approximate the wound to control hemostasis. The wound is then sutured with interrupted sutures of absorbable suture material, four to six generally being sufficient though occasionally in adults eight or ten will be required (Fig. 177). The more accurately the skin edges are approximated, the more rapid will be the healing. Inversion of the skin edges is to be avoided. Another type of circumcision is to draw down the foreskin and clip off with a scissors the redundant prepuce, without making the preliminary dorsal and ventral incisions. This operation, however, entails some considerable danger of injuring the glans. The operation is completed by the application of a vaseline gauze dressing which in children is held in place by a diaper or T-binder. In adults a circular gauze bandage will be employed. The writer does not favor the procedure of tying a small strip of gauze over the wound by means of the long ends of the sutures.

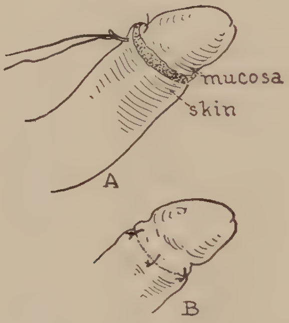

Fig. 177.—*A*, The foreskin has been removed. *B*, Suture of the wound.

The parents or attendants are instructed to change the bandage after each urination or defecation and carefully to irrigate the parts with warm boric solution. The vaseline gauze dressing should be discontinued as soon as possible, preferably after a few hours, and the wound encouraged to dry and form scabs. Where there is practically no bleeding the vaseline dressing may be dispensed with and a dry dressing put on at the operation. A very satisfactory type of dry dressing is to make a curtain of sterile gauze which is suspended from the abdomen by adhesive plaster and hangs down over the recent wound. In adults sodium bromide is often advisable to prevent an erection.

V. URETHRA

1. **Narrow Meatus.**—The urinary meatus may occasionally be so narrow as to interfere with the diameter of the urinary stream and cause some difficulty in urination. Cases of this type are treated either by gradual dilatation with increasing sizes of the sounds or by a meatotomy. The latter operation is performed under local anesthesia and consists in enlarging the meatus by a longitudinal incision at the posterior margin. The hemorrhage will generally be slight and is usually controlled by pressure, although occasionally ligature is necessary.

2. **Hypospadias,** which is the congenital opening of the urethra on the under side of the penis; **epispadias,** which is the congenital opening of the urethra on the dorsum of the penis; and **exstrophy of the bladder,** which is that congenital malformation in which there is a deficiency of the abdominal wall and bladder, so that the latter organ appears to be turned inside out, are all conditions requiring complicated major surgical procedures.

3. **Urinary fistulæ** may occur as a result of wounds of the urethra or of abscesses of the penis and perineum which may cause a communication into the urethra. Most of these urinary fistulæ will close spontaneously in time, but in cases where six months' to a year's trial has been made, it will be advisable to attempt the operative closure. This may be done under local anesthesia with a sound in the urethra. The fistulous tract is dissected down until the urethra is reached and the latter is closed with fine stitches of plain catgut. The external wound will be closed except for a small silkworm-gut or rubber drain.

VI. TESTICLE

1. **Undescended testicle (cryptorchism)** is of fairly common occurrence in young boys (about 1 in 1000), and the degree of the failure of descent is variable. The testicle may rest in the upper part of the scro-

tum, in the inguinal canal, or in the abdominal cavity. The cause is probably an abnormality in the gubernaculum testis.[1] In making the diagnosis one should be careful to distinguish between cases having a true undescended testis and children having a very strong cremasteric reflex. Sarcomatous degeneration is rare in cryptorchism, but, according to Fraser, is more likely to occur in the inguinal than in the abdominal testis. It has been thought that periodic downward traction upon the testicle will accelerate the process of descent. This practice is to be condemned because it is probably useless and is not unlikely to cause masturbation. In young boys it will probably be well to defer operation until a trial of some years has been made for the spontaneous cure. Fraser fixes the age of election for operation at four years. The operative treatment of undescended testicle is major surgical. In adults undescended testicle, with the testis situated opposite the pubic ramus, is always treated surgically because of the danger of traumatism.

2. **Misplaced or Ectopic Testicle.**—The testicle may be congenitally displaced so as to reside under the skin of the abdomen or of the thigh. The treatment of this condition is major surgical.

VII. HYDROCELE

1. **Hydrocele of the Tunica Vaginalis.**—An excessive amount of clear fluid in the tunica vaginalis is described as hydrocele. After the fluid content of the scrotum has been made certain by the demonstration of fluctuation, the existence of a hydrocele will be established by transillumination. This is preferably done in a darkened room by holding a pocket flash-light behind the scrotum. The cavity formed by the hydrocele may or may not communicate with the abdominal cavity. In young children the disappearance of the hydrocele upon compression will be proof of its communication with the abdominal cavity, and a diagnosis of potential hernia may be made. Such cases will require a major surgical operation for cure. Those cases which do not communicate with the peritoneal cavity may be treated by the "bottle" operation (Andrews) or by excision and eversion of the redundant tunica vaginalis (Winklemann). In the Andrews "bottle" operation the testicle is extruded through a small incision in the tunica vaginalis. The sac is thus turned inside out, and the opening may or may not be narrowed by suture to prevent the testicle returning to the tunica vaginalis. The testicle and sac are then returned to the scrotum. This operation is very readily accomplished under local anesthesia. In the excision and eversion operation of Winklemann the parietal layer of

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[1] Fraser, John: Surgery of Childhood, William Wood & Co., 1926, p. 784.

the tunica vaginalis is trimmed away to about $\frac{1}{2}$ inch from its visceral insertion on all sides and these flaps are sutured together behind the epididymis. Particular care should be taken of hemostasis. Hemorrhage is the most serious complication (Young) and the recurrences after radical operation are said to be only 5 per cent. Aspiration of the hydrocele may sometimes be employed as a palliative. It occasionally cures children. A small area of the skin and underlying tissues may be infiltrated with 1 per cent. procain. The scrotum is so grasped that the testicle is well out of the way. The trocar or aspirating needle is introduced into the scrotum with caution in order that it does not penetrate too deeply and thus injure the testicle. The aspirated fluid is a useful culture material and should be preserved in a sterile flask. The injection of irritant drugs, as phenol or iodine, into the sac of the hydrocele, in an effort to bring about its obliteration by adhesions, has been abandoned because of its uncertainty and painfulness.

2. **Hydrocele of the Cord.**—By hydrocele of the cord are meant those small, circumscribed collections of fluid which arise from the cystic enlargement of a portion of the funicular process. These hydroceles may readily be removed under local anesthesia. If there be coincident congenital hernia this defect should receive proper radical treatment. It will be well to remember that in all operations upon the external genitalia the skin is best prepared by painting with the mercurochrome-acetone solution of Young.

VIII. VARICOCELE

In varicocele the veins of the spermatic cord are abnormally enlarged and the scrotum may look and feel somewhat like a bag of worms. This condition has for many years been the excuse for much mistreatment on the part of genito-urinary quacks. The patient is solemnly told that the condition is a very serious one and that their operative procedure is probably the only method of saving them. The large majority of varicoceles will require no treatment whatsoever, as the condition is without danger or significance. In cases where the venous enlargement is so great as to cause an uncomfortable sensation of weight or pain in the testicle or groin an operation will afford relief. The commonest type of operation is to make a longitudinal incision into the scrotum under local anesthesia and from the bulk of the cord structures to isolate the vas together with the artery of the vas and one or two small veins. The remaining enlarged veins are then ligated with transfixion sutures at or near the inguinal ring and below near the testicle. The intermediate portion, some 2 to 5 inches, is then excised and the ligated ends may or may not be sutured together. Campbell[1] has made a very interesting study of varicocele based upon 500 cases. This writer says that the suspension operation devised by Vincent, of the Urological Service at Bellevue Hospital, is the procedure of choice because it uniformly relieves the pain and testicle drag and the postoperative sequelæ are minimal. Campbell describes this operation as follows: "After novocaine infiltration (Fig. 178), a low hernia incision exposes the external ring and the emerging spermatic cord. Further cord infiltration is usually advisable at this point (Fig. 179). The vessels are exposed by a longitudinal incision through the cremaster and the funicular sheath. The anterior vessels are separated from the deferential group as high as the external ring and down to a point, which, when raised to the level of the external ring, will elevate the testicle about 2 cm. higher than it normally hangs. These mobilized anterior veins—constituting the main body of the varicocele—are divided between clamps (Fig. 180) and each is tied securely with a transfixion ligature at least 1 cm. from the cut end so that the ligature will not slip off. The ligature of the proximal stump is cut short and this part is dropped back into the inguinal canal where it retracts from sight. On the other hand, the ligature on the distal stump is left at least 6 inches long. The intercolumnar fascia is now divided and with a knife handle or grooved director a path is burrowed underneath the external oblique to a point opposite the internal inguinal ring. The long ends of the ligature, each threaded on a blunt or aneurysm needle, are introduced

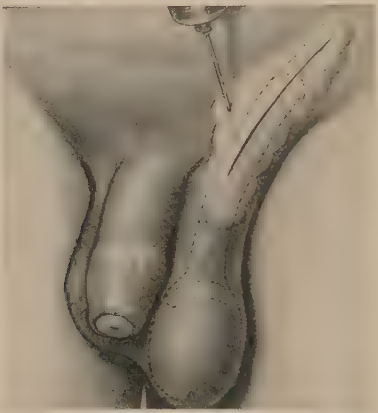

Fig. 178.—Infiltration and site of the incision for varicocelectomy. The incision is made high in the scrotum and extends somewhat above the level of the external inguinal ring. (Campbell, M. F., Surg., Gynec., and Obst., October, 1928.)

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[1] Campbell, M. F.: Surg., Gynec., and Obst., 47, 558, October, 1928.

into the inguinal canal under guidance of the director or knife handle and at a point opposite the internal ring are separately pushed through the aponeurosis of the external oblique. They are then tied over the

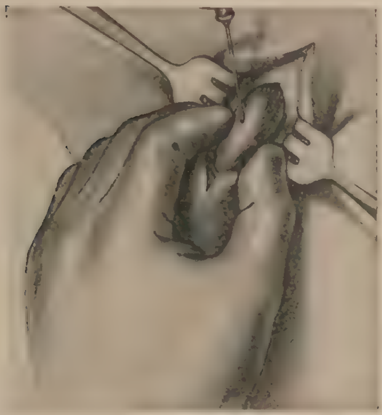
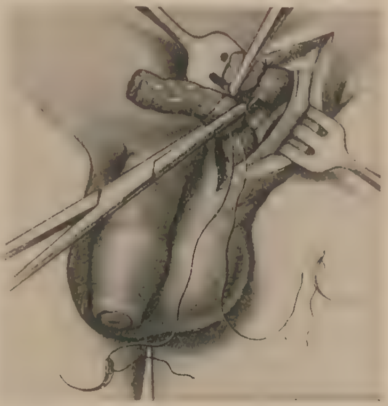


Fig. 179.—After the funicular sheath with its cremasteric covering has been exposed, the cord, which is still in its bed, is well infiltrated. Injection made high into the lower inguinal canal will give a most satisfactory block anesthesia. (Campbell, M. F., Surg., Gynec., and Obst., October, 1928.)



Fig, 180.—Excision of the varicocele. Attention is directed to the transfixion ligature on the proximal venous stump. The distal ligature ends are left long so as to be utilized as indicated in Fig. 181. The vas with its artery and one or two veins are undisturbed. (Campbell, M. F., Surg., Gynec., and Obst., October, 1928.)

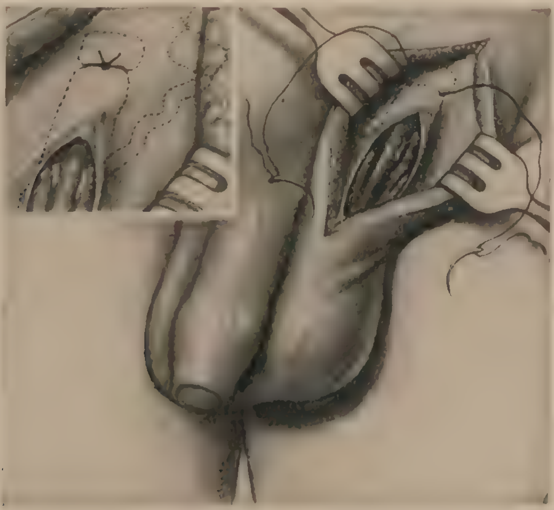


Fig. 181.—The proximal venous stump has dropped back into the inguinal canal and disappeared from view. The distal stump is suspended through the external ring beneath the external oblique fascia elevating the testicle somewhat above its mate. (Campbell, M. F., Surg., Gynec., and Obst., October, 1928.)

few intervening strands of aponeurosis (Fig. 181). The tying of this ligature pulls the distal stump up into the inguinal canal, thus elevating the testicle about 3 cm. higher than its usual level and relieving the vas of all tension. The wound is closed without drainage. We then apply the Bellevue scrotal suspensory. This dressing affords both testicle splinting and suspension until the upper portion of the elevated venous stump becomes partially fibrosed to its new inguinal position. Unless this support is applied, there is likely to be slipping of the suspended organ even though chromic suspension sutures are employed. This method was followed 398 times in this series. In the remainder, the generally used end-to-end tying of stump ligatures after venous excision was performed. Five days in bed, postoperatively, usually suffices; the average period of hospitalization in uncomplicated cases was 6.4 days.

"We are careful, in performing varicocelectomy, to keep away from the tunica vaginalis unless it is to be opened for hydrocele, as trauma will increase the probability of subsequent hydrocele. In elevating the testicle, if one carelessly pulls too hard, the tunica vaginalis will not infrequently be found presenting in the wound, an excellent position for traumatization." A novel orchidopexy for varicocele has been devised by Coutts[1] of Santiago, Chile. He has used it upon fifty patients and the results have been satisfactory. The author calls it the "method of the double pulley" and describes it as follows:

"*First Part of the Operation.*—A skin incision that, starting from the outer third of the symphysis pubis, ascends obliquely upward for 4 or 5 inches following the bisection of the angle formed by the median line and Poupart's ligament. Cellular layers are cut through and edges of surgical wound separated by means of blunt separators. In the inferior part of the wound there appears the external abdominal ring and the venous packets penetrating under it; the shining aponeurosis of the external oblique occupies the superior part and the horizontal muscle fibers attached to the outer half of Poupart's ligament can be easily recognized.

"From $\frac{1}{2}$ to 1 inch above the arciform fibers of the external abdominal ring we make with the bistoury two short parallel incisions in the external oblique muscle fascia and pass downward and under them a Kocher's forceps, forming in this fashion an aponeurotic bridge (Del Valle).

"We next divide longitudinally the different coverings of the spermatic cord and select one of the most dilated veins of the anterior of spermatic packet. After insolating it by means of blunt dissection and softly pulling it outward and downward, we cut it as far up as possible between two catgut ligatures. Once we have done this we pull, by means of Kocher's forceps, the glandular end through and under the aponeurotic bridge.

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[1] Coutts: Ann. of Surg., 88, 1093, December, 1928.

"*Second Part of Operation.*—Between the fibrous layer that continues itself upward with the fascia transversalis and the parietal layer of the tunica vaginalis we slip a soft Péan forceps down into the bottom of the scrotum. Pushing the testicle upward we try to catch with the forceps the small crescentic fold of the tunica vaginalis that passes downward to the bottom of the sac. We easily recognize if we have taken it between the forceps, because on pulling outward the scrotum umbilicates. Holding the scrotum between our fingers we draw this portion of the tunica vaginalis softly outward until it appears in the inferior part of the surgical wound. It can here be easily recognized owing to its smooth, brilliant serous appearance. With the bistoury we make a small incision through this portion of the tunica and pass a Kocher forceps through the gap. By means of this forceps we grasp the vein that hangs over the aponeurotic bridge and, drawing it downward, make it pass through this buttonhole.

"Drawing the vein upward we make it pass once more under the aponeurotic bridge by drawing upward or relaxing our hold on the vein we can leave the testicle at any height we desire. With a strong forceps we then crush under the aponeurotic bridge the different windings of the suspensory vein and passing a strong catgut suture under the block, finishing this part of the operation. We recommend a double ligature in order to insure complete success.

"Under the aponeurotic bridge we place a catgut suture in order to join the fibers of the external muscle fascia. We cleanse the surgical wound and place a suspensory bandage."

A formidable operation is the resection of the lower half of the scrotum. In this case the redundant scrotal skin is removed and the testicle is lifted up. The operation has but rare indications.

IX. OPERATIONS ON THE VAS DEFERENS

1. **Vasostomy.**—In cases of infection of the seminal vesicles Belfield and others have recommended the injection into the vas of silver salts, as argyrol, as an antiseptic measure. This procedure may, however, have some danger of obliteration of the vas. After the injection of these agents *x*-rays will show how beautifully the antiseptic may reach all parts of the seminal vesicles. In this operation the vas is picked up

in the upper part of the scrotum between the thumb and forefinger. It may be identified by its hard, cord-like consistency. Without releasing the tissues thus held, a few drops of local anesthesia are placed into the skin, a small incision made, and the cord is drawn into the wound. The vas is isolated and put on a tension by means of a tape or instrument and a hypodermic needle is introduced into the lumen (Young). The patency of the vas may be tested by injection of methylene-blue which should emerge from a catheter in the prostatic urethra (Young).

2. **Resection of the vas** has received attention in recent years as a method of sterilizing the male without, it is said, causing a loss of sexual power or any interference with the systemically beneficial secretions of the testicle. It has been advocated in the case of the hopelessly insane and in the case of criminals as a preventative to their propagating.

Debatable is the propriety of the employment of this measure in the cases of married couples who for legitimate reasons desire no more children. Enlightened opinion will probably favor its increasing use. In cases of large families where limited income prevents the proper rearing of additional children or in cases where the health of the wife contraindicates further pregnancies, this measure would seem far less dangerous, less formidable, and more available than resection of the fallopian tubes in the female. It will, of course, require a certain amount of sacrifice on the part of the husband, in that he may be permanently deprived of his powers of procreation. In this connection, however, it is to be said that reconstruction of a resected vas is mechanically possible, although extremely difficult successfully to accomplish.

Resection of the vas may readily be carried out under local anesthesia. The vas is picked up between the thumb and forefinger and the overlying skin is infiltrated with local anesthesia. A longitudinal incision is made over the vas, which is then identified by blunt incision. A one-half to one-eighth section of the vas is then excised and the open ends of the remainder are ligated. In some cases it will be advisable to overlap these ends and stitch them in place. The mere excision of a portion of the vas, however, is sufficient to secure sterilization.

CHAPTER XVI

THE FEMALE GENITO-URINARY ORGANS

I. INJURIES

1. **Contusions and Hematomata.**—Falls astride hard objects, blows in the perineum may cause contusions of the labia majora and minora. The swelling may be extremely large and very painful, but will generally yield to rest and hot fomentations. In some cases the subcutaneous effusion of blood may be so large as to cause a hematoma. In most cases this will absorb spontaneously, but where the collection of blood is large and is fluid, it is best treated by aspiration under strictly aseptic precautions and by the application of a pressure pad.

2. **Wounds and Hemorrhage.**—The labiæ are extremely vascular and wounds of them are commonly accompanied by profuse hemorrhage which may be extremely difficult to control. In lesser degree of this injury rest and the application of a snug pressure-pad will take care of the trouble. In many cases, however, it will be necessary to give the patient a general anesthetic and with the aid of a good light and proper assistance the bleeding points will be caught with hemostats and ligated. In some cases packing will be necessary and when the hemorrhage is very severe, ligature of the bleeding tissue *en masse* may be indicated. "In open hemorrhage from a small wound, if pressure does not control it, the wound may be packed with pledgets of cotton dipped in liquor ferri subsulphatis or in tannic-acid powder, and then vaginal packing and vulvar compress employed."[1]

3. **Rupture of the Hymen and Vagina.**—Falls upon picket fences and other forcible injuries may cause a tearing of the hymen and even of the vagina itself. In the more severe cases the rectum may be wounded and the peritoneum invaded; a condition which obviously calls for major surgical interference. The hemorrhage from the hymen may be slight and subside without ligature. On the other hand, very profuse hemorrhages may result from injury to the hymen. "An instance of troublesome hemorrhage from a slight injury is the persistent bleeding that occasionally follows the small tear of the hymen in the first coitus. On account of modesty and embarrassment the

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[1] Crossen, H. S.: Diseases of Women, 5th ed., C. V. Mosby Company, 1922, p. 350.

newly married couple hesitate to call in assistance, and sometimes the bleeding persists for hours—until they finally do call a physician, who may find the bedding soaked with blood and the bride almost exsanguinated."[1] Small wounds of the vaginal wall require no treatment other than antisepsis and will heal spontaneously. Larger wounds will require careful suture with absorbable suture material to insure approximation of the parts.

4. **Laceration and Relaxation of the Perineum.**—Lacerations of the perineum may be the result of external violence or of the traumatism incident to childbirth. Small wounds of the skin in this region will require a few interrupted silk stitches for closure.

Lacerations of the perineum will vary all the way from small rents in the mucous membrane of the vagina to deep tears into the rectum. The tears of the vaginal mucous membrane are distinctly a subject of minor surgical treatment. Before the placenta has been expelled a few catgut approximation stitches may be placed without any anesthesia. Any stitches placed at this time should not be tied until after the placenta has been expelled because of the possibility of their tearing during this procedure. In these second-degree tears, which extend through the perineal body, deep sutures of silkworm-gut are preferable. These are placed 1 cm. apart and at least 0.5 cm. from the edges. Third-degree tears, that is, those which go through the sphincter ani muscles and the rectum, and also old neglected tears of the perineum should be regarded as subjects of major surgical treatment.

5. **Incomplete Abortion.**—The product of conception may be prematurely expelled either as the result of criminal interference or spontaneously. It is not uncommon in either case that some portion of the membranes or of the placenta remain behind in the uterus. These may give rise to a continuous loss of blood which, if untreated, may cause serious injury to the health of the patient. If this condition be a sequel of a criminal abortion, no surgical interference should be thought of unless the hemorrhage is so alarming as to be of immediate danger to the patient. Practically all criminal abortions are accompanied by the introduction of pathogenic organisms into the uterus. Streptococcus and Staphylococcus are common organisms. Gas gangrene infection by the Bacillus welchi has been reported.[2] Any instrumentation inside the uterus is exceedingly dangerous because of

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[1] Crossen, H. S.: Diseases of Women, 5th ed., C. V. Mosby Co., 1922, p. 350.

[2] Beare, F. H., and Cleland, J. B.: Med. Jour. of Australia, 1927, i, 719. Magarey, R., Cleland, J. B., and Sleeman, J. G.: Med. Jour. of Australia, 1927, i, 787. Fuss, E. M.: Zentralbl. f. Gyn., 52, 116, January 14, 1928.

the danger of spreading the infection into the parts adjacent to the uterus or into the blood-stream itself. In these cases rest in bed and watchful waiting is the procedure of choice. In many cases the bleeding will subside entirely under this treatment. The patient should be afebrile for a minimum time of five days before operative interference should be attempted. According to Danforth,[1] the "*indications for curettage* today are practically limited to the removal of the retained products of conception in an incomplete abortion and for diagnosis in an otherwise unexplained hemorrhage. The latter indication usually obtains in older women in whom a carcinoma of the body of the uterus may be suspected. After other means have failed, a curettage is occasionally useful in young women as a therapeutic measure in menorrhagia. This should be made use of with conservatism."

In cases of spontaneous incomplete abortion, dilatation and curettage should be resorted to promptly if active bleeding is present. It is not very good judgment to permit a woman to lose large quantities of blood day after day in the often vain hope that the hemorrhage will subside. It is far better to empty the uterus surgically. If the bleeding be slight, curettage may be deferred several days in the hope of spontaneous completion.

A dilatation and curettage may be regarded as a minor surgical procedure. However, the danger from sepsis and the introduction of pathogenic bacteria into the uterus almost classify this operation as one of major surgical importance. The operation is best performed under general anesthesia. The external genitalia are completely shaved and they and a wide area adjacent are then painted with mercurochrome-acetone solution or 2 per cent. iodine. By the aid of a vaginal speculum the interior of the vagina is then thoroughly painted with the antiseptic solution. A weighted speculum may then be placed in position and the cervix is inspected. If the cervix may not be readily seen, the anterior or posterior lip of it will be grasped by a two-toothed uterine tenaculum and drawn forward to the orifice of the vagina. In many cases a large portion of placenta and membranes will be seen loosely held in the partially dilated cervix and may be withdrawn without effort by the placental forceps or by a simple tissue forceps. This procedure in many cases is all that is necessary. In cases where no placental tissue is visible at the cervix, it will be necessary to proceed with the dilatation and curettage. The cervix is firmly grasped by the upper lip with a uterine tenaculum and is drawn down. A long applicator soaked in 3½ per cent. tincture of iodine is gently inserted into the cervical canal as far as it will easily pass. Uterine dilators of the solid type are then carefully inserted in increasing sizes. These are profitably lubricated by mercurochrome solution. It is extremely important to have the cervix and the dilator under firm control. As the larger sizes of the dilators are reached a certain amount of force will be required to introduce them into the uterine cavity and there is considerable danger that the pointed end of the dilator will slip forward and perforate the uterine wall. After the larger size of the solid uterine dilator is used, the cervix is further dilated by the Hegar dilator, but only if necessary. The blades of this dilator are divulsed with moderate force in all angles of the circumference of the cervix. The pressure will be slow and firm and extreme violence will be avoided for fear of tearing the cervix. After the cervix has been dilated it will very often be possible to remove the retained products of conception by the blunt finger, aided by pressure upon the fundus through the abdominal wall with the other hand (Fig. 182). If this fails, a small placental forceps is inserted in the uterus and any bits of tissue which may be grasped are extracted. The final step is the systematic and extremely careful curettement of all surfaces of the endometrium with

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[1] Danforth, W. C.: Personal communication.

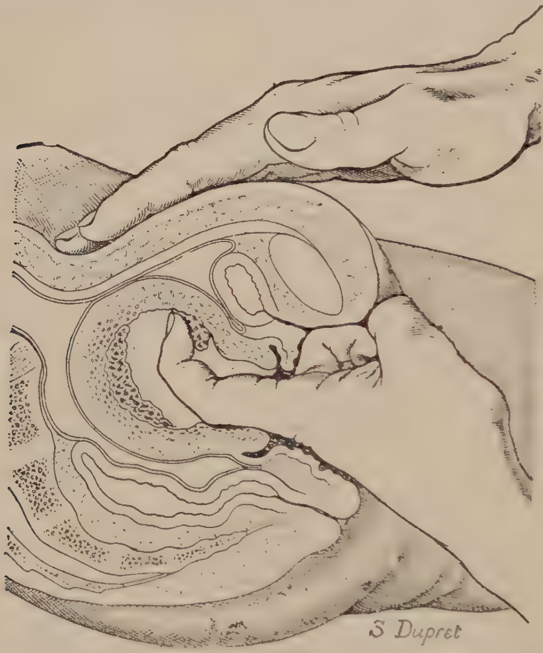

Fig. 182.—Digital uterine curettage. (Maisonnet, "Petite Chirurgie".)

a large sharp uterine curet. A blunt curet is used by some. It is needless to emphasize the extreme danger of uterine perforation if excessive force be applied. This accident has happened so frequently and cases have been reported where even intestines have been curetted down through the cervix, that the peril will be known to all. Extreme gentleness should be the watchword in all curettements. After the curettement has been completed the uterine cavity is snugly packed with uterine packing. This is composed of $\frac{1}{2}$-inch wide sewed gauze and is best put in place by a uterine dressing forceps, care again being taken not to force the instrument through the fundus of the uterus. The tubular mechanical uterine packers with tooth mandarins are preferred by some for this purpose. Where more than one strip of gauze is required to pack the uterine cavity, rather than knot the strips together, they may be attached by the method of Spangler.[1] "When the end of the first strip of gauze is approached, the second strip is started from its tube. In the beginning of the second strip, starting about an inch or two from the end and cutting away from the end, one cuts a longitudinal slit slightly longer than the width of the first gauze. Now, holding the beginning of the second strip flat, one brings the end of the first strip up through the slit in the second strip. Then the end of the first strip is passed round under the second strip and up over the opposite side to the slit. The end of the first strip is now passed down through the slit in the second strip in the opposite direction from its first passage through the slit. The loop thus formed is now set by firm tension on all three ends. The two limbs of the first strip are now grasped in sponge forceps, and the whole union is introduced into the uterine cavity as with the single strip of gauze. Care is taken to make sure that the open end of the V formed by the first strip is directed toward the fundus of the uterus. The packing is completed in the usual manner. Additional strips may be united in the same manner as needed." The vagina is then packed with 2-inch wide sewed gauze packing and the ends of the uterine and vaginal packing are tied together, as a preventive of the danger of losing or forgetting the uterine packing. Danforth[2] ties a 12-inch piece of strong black silk or tape to each strip of packing and brings the end of the silk out of the vagina. These ends are then fastened by adhesive to the inner aspect of the thigh. The ends of the uterine and vaginal packing may be kept separate. A sterile vulva pad is then applied. Both uterine and vaginal packing are removed twenty-four hours after the operation. It is needless to warn against the danger of leaving in the vagina small gauze pledgets.

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[1] Spangler, P. E.: Jour. Amer. Med. Assoc., 87, 754, September 4, 1926.

[2] Danforth, W. C.: Personal communication.

6. **Foreign Bodies.**—(*a*) *Vagina and* (*b*) *Urethra and Bladder.*—The wide variety of foreign bodies which are found in the vagina, urethra, and bladder and their methods of removal were discussed in the section on Foreign Bodies.

7. **Retention of urine** is far less common in the female than in the male, but may occur following traumatism of the perineum, hemorrhoid operations, and perineorrhaphies. The treatment will be catheterization. Catherization in the female is mechanically a simple operation, but the attention to asepsis and antisepsis makes it a procedure subject to most careful measures. The external genitalia will be washed with soap and water and carefully irrigated with boric solution. The sterile gloved hands of the nurse or doctor will then introduce into the urethra a sterile, blunt-tipped glass catheter with a side opening. The catheter is grasped as far back as possible from the tip so that little, if any, of the portion touched by the fingers will enter the urethra. Introduction of $\frac{3}{4}$ to 2 inches is required to enter the bladder. At the completion of the catheterization the prophylactic instillation of 5 to 10 c.c. of $\frac{1}{2}$ per cent. mercurochrome solution or 1 ounce of 1 : 1000 silver nitrate solution should be the routine.

Webb[1] has given the following instructions for cases of postoperative retention of urine on his surgical service. "As soon as postoperative retention of urine is reported the usual methods of treatment should be applied. If the patient does not void promptly the following treatment is to be applied: Insert a catheter in the usual manner and withdraw from 25 to 75 c.c. of urine from the distended bladder and then inject between 15 and 20 c.c. of 20 per cent. borated glycerine through the catheter into the bladder. Withdraw the catheter. Micturition will occur in from ten minutes to one hour in over 80 per cent. of the cases and retention will not recur. The borated glycerin acts on the intraparietal vesical ganglia. *Warning: Borated glycerin must not be injected into an empty bladder. Follow the instructions exactly.* Twenty per cent. borated glycerin is made by heating pure glycerin to hasten solution and adding the required amount of boric acid and then sterilizing in an autoclave."

II. INFECTIONS

1. **Cellulitis** or diffuse pyogenic infection may involve the skin and underlying parts of the vulva. It will be treated by rest and hot boric fomentations and in the event that fluctuation indicates

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[1] Webb, R. C.: Personal communication.

abscess formation, incision and drainage will be carried out, with strict attention to antisepsis and to hemostasis.

2. **Erysipelas** occasionally involves the female external genitalia and will be treated under the general rules laid down for that ailment. Crossen[1] says that "considerable relief will be afforded by applying pieces of absorbent cotton, or gauze, soaked in carbolized olive oil (1 or 2 per cent.) and the application of an ice-bag outside this dressing."

3. **Venereal Diseases.**—The treatment of venereal ulcers and gonorrhea involves the use of but few minor surgical procedures. The treatment of *acute gonorrhea in the female* should be conservative. Rest in bed with external cleanliness is all that is required. Where the state of mind of the patient indicates that something be done, a low-pressure saline or 1 : 5000 silver nitrate douche may be given once or twice daily. When the acute stage is passed, antiseptic irrigations and applications are employed, the former frequently being carried out by the patient herself. The treatment of chronic endocervicitis includes: Puncture of cysts, if they be present, and application of an antiseptic astringent, linear cauterization, and, in marked cases, operative treatment, such as the Sturmdorf. Chronic gonorrheal endocervicitis occasionally is treated beneficially by the placing of dehydrating and antiseptic tampons. Glycerin and argyrol are useful. These pledgets of cotton are tied by cotton strings, which are permitted to protrude externally, and traction on them by the patient at the desired time will remove the tampons.

All vaginal discharges in children should be viewed with suspicion. Eighty per cent. are due to the gonococcus. Stein[2] has made an interesting clinical investigation of vulvovaginitis. He found that it is an infection which frequently is gonorrheal in origin, but which may be non-specific, even in the purulent varieties. The diagnosis rests upon the clinical evidence of the disease and upon the examination of the smear by an expert. In mild non-gonorrheal cases a daily tub-bath is all that is required for a cure. In positive cases of gonorrhea and in suspicious cases, in addition to the daily tub-bath there should be daily injections into the vagina of an ointment composed of 1 per cent. mercurochrome 220 in equal parts of lanolin and vaseline. In 1920 Gelhorn advocated the daily injections of 1 per cent. silver nitrate in an ointment of equal parts of lanolin and vaselin. Stein finds the mercurochrome less irritating, less astringent, and equally efficient as a germicide. In 1924 Dorne and Stein[1] stated that vulvovaginitis can be cured by daily injections of 1 per cent. mercurochrome ointment into the vagina. In the hands of these authors gonorrheal vulvovaginitis was cured by this method in an average of 9.7 weeks and the non-gonorrheal vulvovaginitis was cured in five weeks. They advise the avoidance of irrigations and instillations of strong medicaments into the vagina. The determination of cure is made by the examination of repeated smears over a period of time equal in length to the time of treatment.

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[1] Crossen, H. S.: Diseases of Women, 5th ed., C. V. Mosby Co., 1922, p. 272.

[2] Stein, Irving F.: Surg., Gynec., and Obst., January, 1923, p. 43.

After termination of the treatment the patient should be kept under observation for a while and examinations of smears and cultures made from time to time.

4. **Abscess of Bartholin's Gland.**—A not uncommon sequel of gonorrheal infection in the female is the formation of an abscess at Bartholin's gland. The diagnosis will readily be made by the finding of a red, extremely painful swelling on the labial margin at the site of Bartholin's gland. Fever and other systemic disturbances may be marked. The treatment of abscess of Bartholin's gland is incision and drainage. This will best be carried out under general anesthesia. A vertical 1-inch incision is made at the mucocutaneous border or just posterior to it. After the evacuation of the pus the cavity will be loosely packed with plain or iodoform gauze. The vascularity of the labia is likely to cause the unpleasant complication of a severe post-operative hemorrhage. One should never content himself that the oozing from the wound will subside with pressure and packing, but scrupulously should ligate all bleeding points. Packing will gradually be withdrawn so that the abscess will granulate in from the bottom. Unfortunately, there is a tendency to recurrence and it will be advisable in some chronic cases to completely excise the gland when the infection is dormant. Excision of the gland in the acute infection stage is inadvisable. Discharge from Bartholin's gland abscesses or the fistulæ which result after excision must be regarded as infectious and nursemaids or others afflicted with this condition must be prohibited from the care of small children, particularly girls, for a long interval of time, at least several months after the smears have become negative for the gonococci.

5. **Pelvic Abscess; Abscess of Douglas's Culdesac.**—The diagnosis of abscess of the culdesac is made by the palpation of a tender swelling, just back of the uterus in the vaginal vault. This swelling is tender, and may be fluctuant. Fever will be present. Only a bulging

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[1] Dorne, M., and Stein, I. F.: Illinois Med. Jour., March, 1924.

abscess should be opened. The procedure of opening a pelvic abscess is as follows: The patient is examined under general anesthesia in order to ascertain the most fluctuant portion of the abscess. A vaginal speculum is introduced and after carefully swabbing out the vagina with antiseptic solution, the posterior lip of the cervix is grasped with a tenaculum and is drawn forward. The vaginal mucosa is then carefully cut through immediately behind the cervix and by blunt dissection with scissors and finger the connective tissue behind the uterus is separated until the dense infiltration and resistance indicate that the wall of the abscess cavity has been reached (Fig. 183). With a sharp-pointed scissors a puncture is made into the center of the inflammatory mass. Extreme care should be taken to avoid puncturing the rectum. The edges of the puncture are divulsed and the cavity is explored by the finger. A rubber drainage-tube, with cross-piece to prevent it slipping out, is inserted into the abscess cavity and the vagina is lightly packed with gauze (Fig. 184). The cavity is not irrigated. The cavity should be drained until it is obliterated by granulation tissue. The

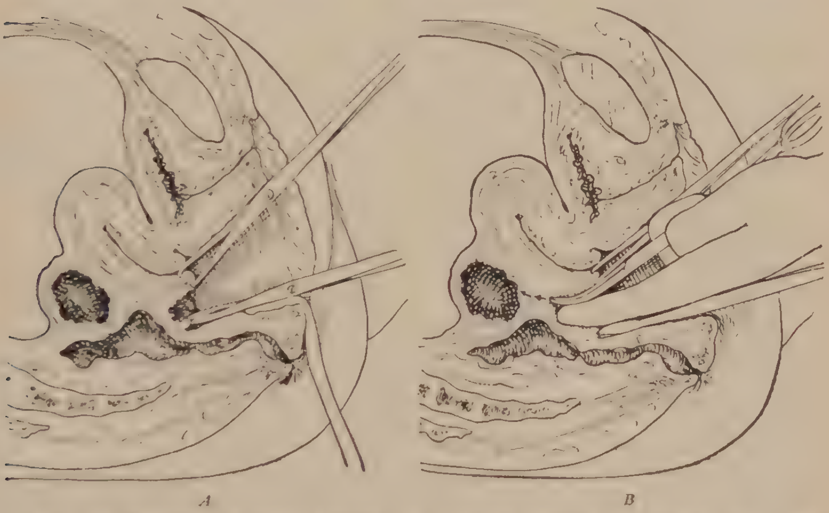

Fig. 183.—Opening a pelvic abscess. *A*, Incision through the vaginal wall. The retractor has been introduced, the cervix caught with a tenaculum forceps, and the vaginal wall clipped through just back of the cervix. *B*, Blunt dissection through connective tissue. The retractor has been removed to permit the fingers to be introduced into the vaginal incision, and dissection is now being made through the connective tissue with the fingers and blunt scissors. The arrows show the direction of the dissection (between the abscess and the uterus and not between the abscess and the rectum), and each arrow may be taken to represent a forward thrust of the blunt scissors beyond the end of the finger. (Crossen, Harry S., Diseases of Women, C. V. Mosby Co., Publishers.)

vaginal gauze is removed after a day or two, and antiseptic vaginal douches may be given one to three times daily.

There are some who believe that abdominal drainage of pelvic abscess is the best treatment.

6. **Ulcers of the Vulva and Vagina.**—Crossen[1] classifies ulcers of the vulva and vagina into seven classes:

(*a*) *Simple Ulcers.*—These are due to the ordinary pyogenic organisms and other common irritants. The "ulcus vulvæ acutum," according to Scherber and Lipschuetz, will give an almost pure culture of Bacillus crassus or B. vaginalis of Döderlein.[2] This type of ulcer should be treated by boric washes and talcum powder, and aluminum acetate vaginal douches should be prescribed for from four to six weeks to prevent recurrence. Stearate of zinc or bismuth subgallate may be used as a drying powder. The inflamed surfaces are kept apart by a pledget of cotton. One per cent. carbolized vaseline is occasionally permissible. The application to the surface of the ulcer, about every third day, of 10 per cent. protargol, or 10 per cent. silver nitrate solution, or 10 per cent. copper sulphate solution will be useful (Crossen).

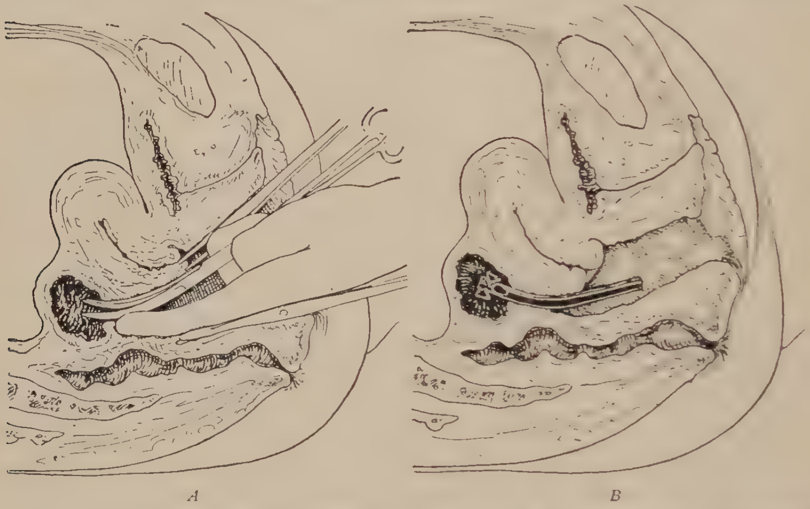

Fig. 184.—Opening a pelvic abscess. *A*, Puncturing the abscess wall. The sharp-pointed scissors have been introduced into the mass under the guidance of the finger, and then opened widely. *B*, Drainage-tube in place. The cross-piece is to prevent the tube slipping out. The tube is cut off about midway in the vagina. The gauze packing extends into the connective-tissue area about the tube, but not into the abscess cavity. (Crossen, Harry S., Diseases of Women, C. V. Mosby Co., Publishers.)

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[1] Crossen, H. S.: Diseases of Women, C. V. Mosby Co., 5th ed., 1922, p. 289.

[2] Taussig, F. J.: Lewis' Practice of Surgery, 10, 6, 1928, Chapter 10, W. F. Prior Co., Inc.

(*b*) *Chancroid.*—This is an infectious ulcer caused by the Ducrey bacillus and transmitted almost exclusively by sexual intercourse. Twenty-four to forty-eight hours after infection a small pustule with an inflammatory base appears. In several days or a week an ulcer will have formed. This ulcer has sharp, "punched-out" margins and a necrotic base. It is surrounded by some inflammatory edema. The ulcer increases in size more rapidly in the vagina than on the external genitalia. The course lasts two to three weeks. A secondary ulcer is likely to develop by auto-inoculation, a characteristic of chancroidal ulcer. The earlier the chancroid is treated, the less will be the likelihood of the formation of a suppurating buboe. "The ulcer is cleansed and then covered with a pledget of cotton soaked in 20 per cent. cocaine solution, which is left in place for five minutes" (Crossen). Every portion of the ulcer is then thoroughly cauterized with 95 per cent. carbolic acid. After cauterization alcohol is first applied and then a carbolized vaseline ointment.

(*c*) *Syphilis.*—The chancre is the primary lesion of syphilis. The diagnosis is made certain by the demonstration by the dark-field microscope of the Spirochæte pallida. The chancre develops two or three weeks after the infection. The dry papule, superficial erosion, or ulcer is accompanied by the induration which is characteristic of syphilis ("hard chancre"). As soon as the diagnosis has been established, antiluetic treatment will be instituted. For the local lesion, simple cleanliness and mild antisepsis will be all that are required.

(*d*) *Tuberculosis.*—Tuberculous ulcers begin as single or multiple nodules which break down into ulcer formation. These ulcers may coalesce until an extensive area is involved. The diagnosis is confirmed by the finding of the tubercle bacilli. *x*-Ray and radium are used in the treatment and excision may be employed in the smaller lesions. For generalized accompanying tuberculosis, general systemic measures are to be employed.

(*e*) *Granuloma Inguinale.*—The diagnosis and treatment of granuloma inguinale have been described elsewhere.

(*f*) *Malignant Disease.*—The consideration of malignant disease does not belong in the realm of minor surgery.

(*g*) *Ulcus Rodens Vulvæ.*—This is a destructive chronic ulcer which cannot be classified in any of the preceding classes. The treatment is that of simple ulcer plus iodides and, in some cases, *x*-ray.

Eversion of the Cervical Mucosa (Ectropion—"Erosion").—In this condition there is a red, hyperemic zone of variable extent about the internal os. The treatment is cauterization with the thermocautery. The Sturmdorf operation is to be recommended. This operation is a major surgical procedure.

III. TUMORS

1. Benign.—(*a*) *Lipoma.*—The vulvæ not infrequently are the site of lipomata which may attain considerable size. The smaller tumors require no treatment, but the larger ones, because of the inconvenience occasioned by their size, will require removal. This may be accomplished under local anesthesia with strict attention to antisepsis and hemostasis.

(*b*) *Retention cysts, fibromata, lymphangiomata, myxomata, angiomata* are other benign tumors which may be found upon the vulva. All of these tumors may be removed under local anesthesia, but in the more vascular ones very careful attention must be given to hemostasis. *Papillomata* (or *condylomata acuminata*), sometimes called *acuminate warts*, are benign tumors of epithelial origin. These tumors are multiple in origin and may be so extensive as to cover the entire vulvar skin. They are practically pathognomonic of gonorrheal infection. These warts are satisfactorily treated by snipping off with the cautery blade (Taussig).

(*c*) *Urethral Caruncle.*—At the external urinary meatus, particularly in elderly women, there often occurs a benign polypoid overgrowth of the mucous membrane. These urethral caruncles have a red, velvety appearance similar to that of fresh granulation tissues and are elevated from the surrounding surface. They are very fragile and bleed easily. They are of two types—the papillomatous and the angiomatous. The former are far more common and are covered by stratified squamous or transitional epithelium supported by a connective-tissue framework.[1] They are exceedingly irritating to the patient who has one. There is pain, with and without urination, burning, and frequency. The treatment of urethral caruncle presents some difference of opinion. They are prone to recur. The very small caruncles are very satisfactorily treated with cauterization by fused silver nitrate. The larger ones are treated either by excision or by fulguration. Excision of a urethral caruncle is rather difficult to perform under local anesthesia and general anesthesia would be the choice. Te Linde[2] says: "For complete removal of the caruncle surgically, a circular incision may be made around the meatus and while gentle traction is made on it, the urethral membrane is dissected free in a way analogous to the Whitehead operation for hemorrhoids. The freed distal portion of the urethra is then excised beyond the point of origin of the caruncle and the shortened urethra sutured to the edge of the circular incision. If the caruncle is small it may be possible to remove it completely by resecting only a small part of the distal portion of the posterior wall of the urethra. A disadvantage to the surgical treatment is that in case the urethra is too much shortened, partial incontinence may result. It is important to remove all of the caruncle as they have a tendency to recurrence. The advocates of surgical diathermy in the treatment of urethral caruncles contend that this method of treatment is more simple to carry out and is accompanied by less hemorrhage. Where fulguration is carried out, it may be advisable to clip off the caruncle and to fulgurate the base.

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[1] Te Linde, R. W.: Lewis' Practice of Surgery, 10, 6, 1928, Chapter 11, W. F. Prior Co., Inc.

[2] Te Linde: Loc. cit.

(*d*) *Urethral Polyp.*—Wynne[1] reported a case of a pedunculated urethral polyp. His patient had a fiery red, insensitive polyp, measuring 10 × 8 × 3 mm., which dangled at the end of a pedicle 1 cm. in length. It was attached to the posterior urethral wall 0.5 cm. above the external meatus. The polyp was removed with a small cautery knife.

(*e*) *Cervical Polyp.*—Polypoid growths may occur on the cervix uteri. These polypi are bright red, friable, pedunculated growths which may be an inch or more in length. They are adenomatous or fibrous pedunculated tumors arising from the cervix. These tumors are generally benign but malignant change may uncommonly occur. They may give rise to troublesome bleeding and vaginal discharge. The treatment is surgical and consists of their removal. This may be done under local anesthesia or owing to the low sensitivity of the cervix, without any anesthetic. These polypi may be removed by slow tortion or they may be removed by the method described by Marztloff.[2] This surgeon, in the cases which have an attachment high in the cervical canal, uses a simple wire snare tonsillotome (Fig. 185). The cervical canal is dilated, the wire slowly tightened over the base of the pedicle, and if oozing occurs, plain or iodoform packing is left in place for forty-eight hours. Or the polyp is simply excised at its base or cut off with a scissors. Simply twisting the polyp off is sometimes practised. The control of bleeding is particularly to be emphasized in this connection. Wherever possible Martzloff advises a preliminary transfixation-ligation of the pedicle. It will be well to have good light and good assistance to insure the hemostasis and to keep the patient under observation for several hours, or longer, after the procedure. The writer has removed such a polyp in his office and has had the embarrassing experience of having his patient taken to the hospital in the middle of the night by another physician because of a profuse postoperative hemorrhage. Cervical polypi are practically always benign, but this does not excuse the surgeon from the burden of having an accurate histological diagnosis made.

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[1] Wynne, H. M. N.: Jour. Urol., 16, 315, October, 1926.

[2] Martzloff, K. H.: Lewis' Practice of Surgery, 10, 10, 1928, Chapter 14, W. F. Prior Co., Inc.

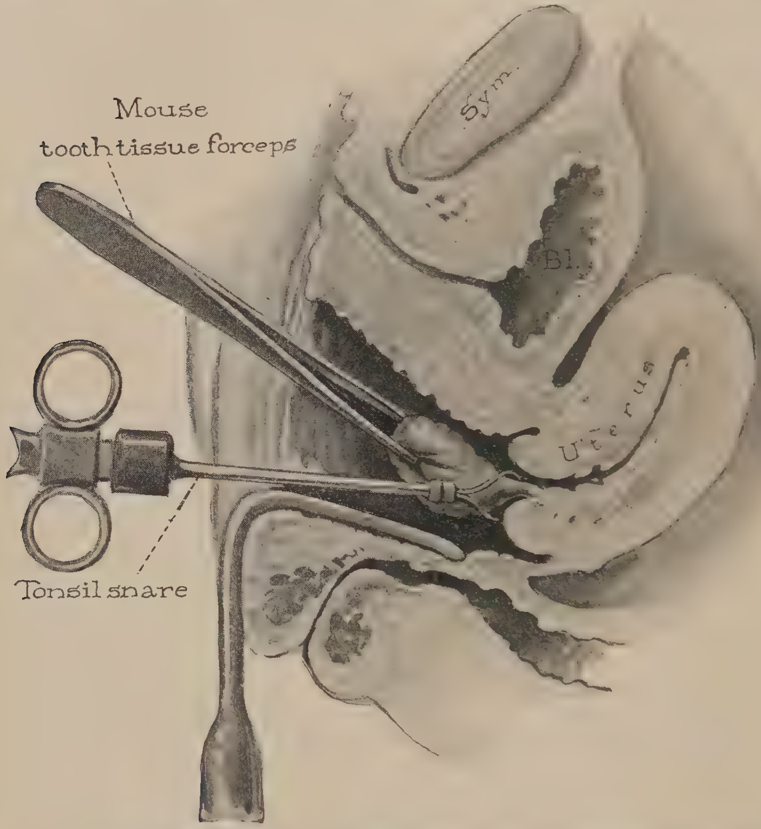

Fig. 185.—Schematic sketch in sagittal section to show method of removing a cervical polyp with an ordinary tonsil snare. The wire loop of the snare has been slipped over the mouse tooth tissue forceps which steadies the polyp. The wire loop has been shortened preparatory to crushing the pedicle. In some instances it may be helpful to steady the cervix with a Cullen three-pronged tenaculum or some similar instrument. (Martzloff, Karl H., Lewis' Practice of Surgery, W. F. Prior Co., Inc., Publishers.)

(*f*) *Condylomata.*—Condylomata are excrescences which are found in the neighborhood of the labia majora, clitoris, and perineum. Those which are flat and moist are due to secondary syphilis, and yield promptly to antiluetic treatment. The treatment of the others is described under Benign Tumors, p. 342.

(*g*) *Vaginal Cysts.*—Cysts of various types are occasionally found in the vagina. They vary "from the size of a pea to that of a cocoanut, but the great majority are less than 3 cm. in diameter."[1] The removal of a large vaginal cyst is a major surgical procedure. Small ones may readily be removed under local anesthesia ($\frac{1}{2}$ of 1 per cent. of procaine solution).

(*h*) *Cysts of Bartholin Gland.*—As a consequence to infection, generally gonorrheal, the outlet of Bartholin's gland may become occluded and in consequence there will occur a cystic accumulation of Bartholin's gland. The resulting cyst of Bartholin's gland may attain the size of a marble or larger. When not acutely inflamed, it may easily be removed, but attention must again be called to the necessity of strict hemostasis. Removal is best done in the operating room under general anesthesia.

(*i*) *Cysts of the canal of Nuck* are analogous to hydroceles of the cord in the male. They are cystic collections of fluid enclosed in a peritoneal covering. They are found associated with the round ligament in the inguinal region. It is said that this condition may disappear spontaneously in young girls. The treatment is excision under local anesthesia.

(*j*) *Elephantiasis.*—Elephantiasis is a chronic disease of the lymphatics, characterized by hypertrophy of the skin and the subcutaneous tissue. This "stasis hypertrophy" (Crossen) "may be due to persistent ulceration with resulting scar tissue, or to an obstructive disturbance in the inguinal lymph-glands, or to a local invasion of the lymphatics by a parasite (filaria)." The legs and the external genitalia are principally affected. The vulva may as a result become ulcerated and fissured.

The treatment of the ulceration is cleanliness and mild antiseptics, such as those described in the treatment of ulcers. The treatment of the larger masses is excision generally under general anesthesia. The smaller masses may be removed under local anesthesia.

(*k*) *Fibroids.—Radium Treatment.*—Danforth[2] gives the following indications for the use of radium in fibroids: (1) The fibroids should be small, not larger than a two and one-half to three months' pregnancy; (2) the patient should be over forty; (3) the fibroid should be reasonably symmetrical; (4) there should be no recent or remote infection in the pelvis; (5) there should be no ovarian pathology present; (6) the fibroid should not be of the pedunculated submucous variety. Usually it will be necessary to dilate the cervix before it can be possible to put the radium in place. This will be done as described above. Danforth recommends the following dosages for radium: For fibroids, 1500 milligram hours with a 1 mm. brass and rubber screen; for myopathic bleeding, 1200 milligram hours; for carcinoma, 3000 to 3500 milligram hours with part of the radium applied by needle. The proper dosage of radium having been determined upon, it is placed in a metal capsule and sterilized by phenol and alcohol solutions. It is then fastened by means of wire through the eyelet in the end of a catheter and wrapped with dental rubber dam. The capsule is placed in the proper position and the wires are fastened to the skin with adhesive plaster to the lateral margins of the vaginal orifice. Where radium needles are used, these are simply grasped with a hemostat and forced into the substance of the cervix.

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[1] Wynne, H. M. N.: Lewis' Practice of Surgery, 10, 24, Chapter 12.

[2] Danforth, W. C.: Personal communication.

2. **Malignant Tumors.**—(*a*) *Carcinoma* and *epithelioma* of the female genitalia are problems of major surgery. However, the diagnosis of carcinoma of the body of the uterus is usually made from histological examination and uterine scrapings. The procuring of the scrapings is a minor surgical procedure. Women, particularly those who are elderly, who suffer from an otherwise unexplained metrorrhagia, must be suspected of possibly having carcinoma. In these cases a dilatation and curettage will be carried out in the manner described previously (see p. 333). In the majority of gynecological clinics cases of carcinoma of the cervix or inoperable carcinoma of the fundus uteri, certain cases of fibroids of the uterus, and cases of so-called myopathic bleeding of the uterus occasionally are treated by the insertion of radium into the uterine cavity. Most cases of carcinoma of the fundus uterus should be operated upon.

IV. CONGENITAL AND ACQUIRED DEFORMITIES

1. **Imperforate Hymen.**—Certain girls are born with an intact hymen which completely closes the vaginal orifice. This causes no symptoms until the onset of menstruation, when despite the presence of other menstrual symptoms, there is failure of the flow to escape to the exterior. The condition should be let alone until the onset of menstruation. This causes a damming back behind the hymen and the formation of a hematocele, which fills the vagina and even may distend the uterus and fallopian tubes so greatly that they may be palpable above the symphysis. Attention to the condition is attracted

by the delay in onset of menstruation and by a darkened and bulging hymen. The condition is readily relieved by cross-incision through the hymen, generally best performed under general anesthesia and with careful attention to hemostasis. The vagina should not be irrigated.

2. **Atresia of the vagina** is the congenital narrowing or partial closure of the vagina. According to Wharton,[1] it is rarely found except in cases of double uterus and it is generally accompanied by amenorrhea. The treatment, in the few cases in which it may be indicated, is major surgical.

3. **Hermaphroditism.**—Abnormal development of the external genitalia may be such as to bring about the condition of hermaphroditism or doubtful sex. The clitoris may be enlarged to resemble a penis and the labia may resemble a scrotum. Conversely, the penis may be very small and resemble a clitoris and the scrotum may resemble the vulva. The determination of sex depends not upon the external genitalia, but upon whether or not testicles or ovaries are present. This, of course, may be impossible to determine without operation. The writer has seen an extremely interesting case which he reported in 1924.[2] In this case a "girl" of seventeen years was brought to the writer because of failure to menstruate. The external genitalia were of the female type. The mother of the patient, in giving the history, remarked that the child had been operated upon in London, England, at the age of three, for inguinal herniæ. A letter to the London hospital brought about a most interesting answer. When the child was operated upon both inguinal herniæ were repaired, but in the sac of each inguinal hernia was found a *testicle*. One of these was removed and the other left in place. The child, of course, was not informed of "her" true sex, but the mother was told the true conditions of affairs.

A few cases of true hermaphroditism, that is, individuals having both ovary and testicle, are on record. Sheppard's[3] is perhaps the most remarkable. This case was accidentally discovered in the dissecting room and in consequence was verified by complete gross and microscopical examination (Wharton). In pseudohermaphroditism only one type of gonad is present, but varying degrees of bisexuality are present in the genital organs. In some cases a plastic operation will remove the external evidences of bisexuality and will save the patient no little embarrassment. "It is usually better to have the sex conform to the external genitalia and the general appearance, rather than to attempt to impose upon a person a sex which, although scientifically correct, may cause continual embarrassment."[1]

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[1] Wharton, L. R.: Lewis' Practice of Surgery, 10, 44, Chapter 2.

[2] Christopher, Frederick: Jour. Amer. Med. Assoc., 83, 1767, November 29, 1924.

[3] Sheppard, Hubert: Anatomical Record, 19, 55, 1920, quoted by Wharton.

4. **Varicose veins of the vulva** rarely require surgical treatment. When extremely large, however, they may be excised, preferably under general anesthesia and with the usual strict precaution in regard to hemostasis which this region requires.

5. **Prolapse of the Uterus.**—Cases of descensus uteri or prolapse of the uterus may be so marked that the uterus will present at the vaginal orifice or even completely escape from the vagina. The treatment of choice in this condition is a major surgical operation, generally an interposition operation or a hysterectomy. Cases where this will be impossible, minor surgery affords considerable relief by the application of a pessary or truss, the large bell of which fills the vagina and holds the uterus in place. A simple hard-rubber ring of doughnut shape and suitable size is the most frequently useful. It should be changed at least every two months. The Menge pessary is useful.

6. **Vesicovaginal fistula** and (7) **rectovaginal fistula** require major surgery for treatment.

8. **Pudendal Hydrocele.**—In this condition there is a collection of fluid in a canal which may have persisted along the round ligament, the internal end of the canal being closed. It corresponds to a hydrocele of the cord in the male. The injection treatment is uncertain and unsafe. The treatment of choice is excision.

[1] Wharton: Loc. cit.

CHAPTER XVII

THE ANUS AND RECTUM

I. METHODS OF EXAMINATION; HEMORRHAGE; WOUNDS

1. **Methods of Examination.**—In all afflictions of the anus and rectum the external region should first be carefully inspected. This will be conveniently accomplished with the patient lying in the semi-prone Sims' position, with the upper leg acutely flexed. The buttocks may then be spread apart and the patient instructed to bear down as if going to stool. External hemorrhoids and fissures will readily be noted by this procedure. The gloved and well-vaselined finger will then be inserted in the rectum. This must be done slowly and gently and in the proper direction, so as not to excite pain and spasm of the sphincter anus. Internal hemorrhoids are rarely palpated, but the presence of foreign bodies or firm neoplasms, as rectal polypi, adenomata or carcinomata will be made out. The next step is the instrumental examination with anoscope, proctoscope, or sigmoidoscope. The ordinary non-inflating anoscope or proctoscope is well lubricated and gently inserted into the rectum while the patient is cautioned to bear down and the instrument is inclined backward toward the sacrum at the proper angle. The mandarin of the instrument is then withdrawn and with the proper illumination the interior of the lower rectum will be visible. As the proctoscope is withdrawn, the collapsing walls of the rectum will come into view and internal hemorrhoids, hypertrophied papillæ, and other pathology will become apparent. When the sigmoidoscope is used and also certain types of proctoscope the external orifice of the instrument is closed with a glass window and the lower portion of the bowel is inflated with air. By this means a larger surface of rectal mucosa is inspected and a better idea of the interior is obtained.

2. **Hemorrhage from the rectum** is always to be the subject of most careful inquiry, as not infrequently the cause of its origin may be a serious ailment. Hemorrhage from the rectum may be brought about by malignant growths, by hemorrhoids, by ulcerative colitis, by foreign bodies, or by wounds. It is important to make an accurate diagnosis as to the cause of the hemorrhage, as naturally the treatment will vary considerably. The blood of hemorrhage from the lower rectum is al-

ways bright red in color in distinction to the black, tarry blood from hemorrhages higher up in the intestinal tract.

3. **Wounds.**—The rectum may be wounded by falls astride sharp objects, such as points of picket-fence, and the like. The measure of utmost importance in this connection is the determination behind the shadow of doubt as to whether or not the object that has penetrated the rectum has perforated into the peritoneal cavity, or if there is possibility of fecal infiltration of the perirectal planes of cellular tissue. It is essential to have free exposure of the site of the injury by anal dilatation or, if necessary, by incision. Palpation of the rectal wound will not suffice, it must actually be seen. The bleeding points will either be ligated singly, or they will be controlled by mass sutures. When it is suspected that wounds of the rectum may have caused an invasion of the peritoneum, the exact site of the wound in the rectum must, if possible, be determined by proctoscopical examination. Its size, and, if possible, its depth will be noted. If there be signs of peritoneal irritation, such as pain, rigidity, vomiting, fever, increase in pulse-rate, leukocytosis, etc., an exploratory laparotomy should be at once carried out. Small wounds of the anus or lower rectum will heal kindly without suture. The larger ones (from 1 to 1½ inches or more) may be approximated with a few interrupted catgut sutures. This is permissible only in very recent wounds. The likelihood of infection is great in the rectum and most wounds will heal more kindly without suture. A small drain is inserted at the lower angle. In all cases where the sphincter has been severed it will be advisable to attempt to approximate the ends by suture. This procedure is best effected under general anesthesia and may call for all the resourcefulness and the skill of major surgery.

4. **Pneumatic Wounds.**—Of recent years there have been reported in the literature a number of serious, fatal injuries resulting from the vicious habit of factory employees placing at or near the anus the nozzle of a pneumatic-pressure hose. The air is forcibly injected into the intestinal tract and has been known to burst the intestine at various places. These cases are always subjects of major surgery.

Koontz[1] has reported a very interesting case in which there was a gaseous cyst in the ischiorectal space. This cyst apparently had arisen from a minute traumatic rupture of the rectum during a polo game. The small rectal opening closed at once. The cyst was incised from the outside, and healed promptly by granulation.

5. **Wounds from Treatments or Applications.**—Unskilful passage

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[1] Koontz, A. R.: Jour. Amer. Med. Assoc., 91, 382, August 11, 1928.

of anoscope or proctoscope may wound the rectum. Unskilful packing, or the too forcible introduction of a sharp enema nozzle may bring about the same result. The inadvertent loss in the rectum of nozzles of irrigating outfits may cause traumatism and, if left too long, ulceration of the rectal wall.

6. **Foreign Bodies in the Rectum.**—These have been described in the section on Foreign Bodies.

7. **Impacted Feces (Coprostasis).**—In patients who are extremely constipated or who because of painful conditions about the anus deliberately refrain as long as possible from bowel movements, the feces in the rectum may become hard and impacted. The condition may be so severe that the patient actually will be unable to expel the fecal material or the efforts to do so will be so painful that he will not have the courage to persist in them. The treatment consists of the digital breaking up of the impacting. In severe cases this will require anesthesia.

II. INFECTIONS AND ULCERS

1. **Papillitis.**—The rectal papillæ may become enlarged and inflamed and cause considerable discomfort from pain and irritation. The treatment is injection of $\frac{1}{8}$ per cent. eucaine solution (Gant) and crushing the papillæ or destroying them by fulguration. They may also be excised or ligated at the base.

2. **Proctitis.**—Inflammation of the rectum may arise from a wide variety of causes and organisms. It varies in degree and in location, and if untreated may bring about most serious results. According to Gant,[1] "acute catarrhal proctitis may disappear spontaneously, but treatment is essential in most cases. This class of patients recover more quickly when put to bed, restricted to a diet composed of soups, broths, gruel, soft-boiled eggs, or scraped meat, and the rectum is cleared of food remnants, hardened feces, mucus, and irritating discharges by normal saline or boric-acid irrigation, or an enema following a dose of mineral water or sulphate of magnesia or soda. The rectum is cleansed twice daily with an antiseptic or astringent irrigant, the strength of which is increased when erosion or ulcers are numerous or large; silver nitrate, 1 : 3000; thymol, 2; potassium permanganate, 1; boric acid, 5; carbolic acid, $\frac{1}{2}$; hydrastis—non-alcoholic, 1; argyrol, 6, or ichthyol, 2 per cent.," using a return-flow irrigator.

3. **Cryptitis.**—This condition is an inflammation of rectal pockets, Morgagni's crypts. It is accompanied by pain and itching. The

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[1] Gant, S. G.: Diseases of the Rectum, Anus, and Colon, W. B. Saunders Co., 1923, vol. i, 262.

pockets are exposed by a speculum and irrigated with warm water and swabbed with pure ichthyol. A nut-gall and stramonium ointment admininstered through a "pile pipe" is often useful. The surgical removal of the diseased crypts generally will be necessary.

4. **Sphincteralgia (Spasm of the External Sphincter).**—In this condition there are sudden, involuntary, painful, contractions of the sphincter. It is caused by any irritant or lesion in the vicinity of the anus. The treatment includes morphine and atropine by hypodermic, hot sitz-baths, or hot-water bags to the anus. Gant recommends the following ointment to be used through a metal pile ointment applicator immediately after defecation:

Morphine sulphate	gr. viij	0/53
Belladonna ext.	gr. x	0/6
Lanolin	ounce j.	0/3.—M.

The sphincteralgia will not be cured, however, until the underlying cause has been removed. Foreign bodies, fecal accumulation, and irritating discharges should be removed. Fissures, ulcer, hemorrhoid, etc., should be remedied. Many cases are relieved by the dilatation of the sphincter by anal dilators or by digital dilatation.

5. **Chronic Fissure in Ano.**—In this condition there is a longitudinal crack or fissure in the mucosa of the anus. Probably it is originally caused by the passage of a constipated stool, a hard vegetable or material containing seeds. Not infrequently at the border of anus at the outer end of the fissure a "sentinel pile" develops. The fissure is extremely painful and at times very difficult to heal. It causes a reflex spasm of the sphincter ani muscle, which in turn interferes with the fissure, thus completing a vicious circle. Cauterization of these fissures will silver nitrate and other agents is generally unsuccessful. The treatment of choice is the excision of the entire fissure under local anesthesia. The sphincter ani will first carefully be dilated. Polypi, if present, will be excised. The fissure or ulcer with its overhanging edges is excised. The sphincter muscle is not cut. The wound edges may be approximated with interrupted catgut stitches, but it is generally better to leave the defect open and cover it for a day with a small piece of vaseline iodoform gauze. Enemata consisting of 2 ounces of oil in a pint of water are given the day after the operation and daily thereafter (David—Fig. 186).

Inasmuch as *local anesthesia* is very satisfactory in operations for chronic fissure in ano, hemorrhoids, polypi, prolapse of the rectum, benign tumors, incontinence of the sphincters, and certain types of fistula in ano (David) it is thought that a description of it would be proper at this point. The following methods are used and described by David[1]:

"The evening before the operation and again two hours before the operation the patient is given an enema of 1 pint of luke-warm water. The perineal and gluteal regions are shaved. The operative field is scrubbed with soap and water. Regular diet is given, excepting only foods containing hard sharp particles, such as seeds or bran, which are indigestible and capable of causing trauma. No preliminary sedative is given, as it has been found that vomiting occurs in about 20 per cent. of the patients receiving preliminary sedatives. The patient is in a position for lithotomy with the knees resting in supports that prevent excessive flexion of the thighs and discomfort from pressure. A 10-c.c. rectal syringe with a right-angled adapter allows the needle to be introduced into different planes by simple rotation of the syringe, and at the same time permits the operator's hand holding the syringe to be out of the line of vision in the field. Three lengths of Record needles are used, the small size for intradermal wheals, and a 5- and a 10-cm. length for deeper structures. These needles must be kept sharp and free from rust. The practical significance of the nerve supply in regard to anesthesia by injection is that the internal pudic nerve breaks up into many fibers before entering the field and that the most

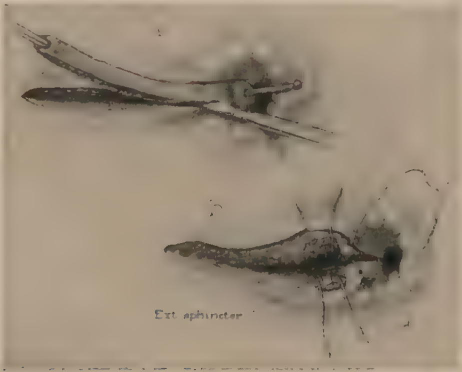

Fig. 186.—Simple fistula in ano. *a*, Probe passed through the fistula into the rectum. Excision of the whole tract. *b*, Where all the fibers of the external sphincter muscle are cut mattress-sutures are introduced to bring the deepest portions of the sphincter together and thus prevent retraction of the ends. (David, Vernon C., Surgery of the Rectum and Anus, vol. v, Nelson Loose-leaf Surgery, Thomas Nelson & Sons, New York, 1927.)

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[1] David, Vernon C.: Nelson Loose-leaf Surg., vol. v, 175, Thomas Nelson & Sons, 1927.

sensitive area is the region of the mucocutaneous line in the anus. With the finer needle, intradermal wheals are raised about two fingers in breadth from the anus on the right and left side (Fig. 187, *a*). The production of these wheals is painful, and the patient should be warned of the needle puncture. These white wheals raised in the skin produce an instantaneous pressure anesthesia and can be used as sites for the re-introducing of needles, without pain to the patient. The 5-cm. needles are now put on the filled syringe and introduced by way of one of the lateral wheals through the skin in the subcutaneous

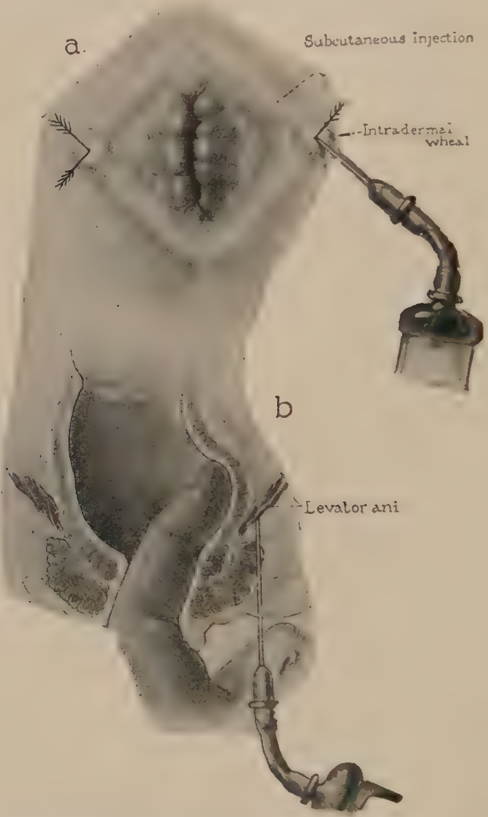

Fig. 187.—Local anesthesia for minor surgery of the rectum. *a*. Lateral intradermal wheals made by injection of ½ per cent. novocaine under the papillary layer of the skin. Arrows indicate direction of needle put through these wheals to make a circular subcutaneous injection. *b*, Left index-finger hooked around the internal sphincter muscle. Long needle passing through an intradermal wheal through the peripheral fibers of the external sphincter muscle to the level of the levator ani muscle. The injections are carried out around the whole circumference of the rectum. (David, Vernon C., Surgery of the Rectum and Anus, vol. v, Nelson Loose-leaf Surgery, Thomas Nelson & Sons, New York, 1927.)

tissue. Novocaine is then injected under the skin with the needle advanced first toward the perineum and then toward the coccyx (Fig. 187, *a*). The process is repeated for the other side. About 30 c.c. of anesthetic solution are used for the complete subcutaneous circular injection. To inject this fluid without pain to the patient it is necessary to keep the plunger of the syringe in constant motion in order that a pressure anesthesia may be produced in front of the advancing needle. The point of the needle should be kept in constant motion in order that the anesthetic may be distributed evenly and no great amount injected into a small vessel, should one be punctured. This procedure should take about five minutes, and should be conducted slowly and with perfect co-ordination, as sudden or nervous movements are apt to alarm the patient. The 10-cm. needle is now put on the syringe. The left index-finger is lubricated and introduced through the anal ring until the tip of the finger can be gently hooked around the upper border of the internal sphincter, which lies just below the easily palpable levator ani insertion. The long needle is now inserted through one of the lateral wheals and pushed forward just outside of the margin of the external sphincter muscle. Anesthetic solution is constantly injected until the end of the needle is just opposite the end of the finger in the rectum (Fig. 187, *b*). The needle is not palpated by the finger in the rectum, as it is about an inch away from the bowel. The needle is now withdrawn so that the syringe may be refilled by an assistant. The index-finger should remain in the rectum until the anesthesia is completed. The same process is now repeated through the same wheal, except that the point of the needle inclines first anteriorly and then posteriorly, so that a wall of anesthesia is produced on that side. This process is next repeated on the opposite side, about 30 c.c. of ½ per cent. novocaine-adrenalin solution being used on each side. The skin over the perineum is now insensitive from the anesthetic which was injected subcutaneously at the start, so the long needle is introduced just in front of the anus and about 5 c.c. is injected between the sphincter and the perineal muscles anteriorly. A posterior puncture is also made, and about 10 c.c. of anesthetic solution is injected just outside of the sphincter muscles. The deep injections will occupy about ten minutes of time and will consume about 90 to 100 c.c. of ½ per cent. novocaine-adrenalin solution. Before inserting the needles the skin is bathed with an alcohol sponge to assure continued asepsis. The operative field should now be anesthetic. If the adrenalin used is not deteriorated, the anesthesia will last about two and one-half hours."

6. **Perirectal and Anorectal Abscesses (Ischiorectal Abscesses).**—Abscesses are not uncommon in the soft parts adjacent to the lower rectum and the anus. The cause of these abscesses generally is infection originating from a small abrasion of the rectal mucous membrane. Pathogenic organisms entering through such an abrasion invade the adjacent soft parts and the resulting infection may go on to abscess formation. Staphylococcus, streptococcus, and the colon bacillus commonly are present. The patient suffers from extreme pain and there is exquisite tenderness on the palpation of this region, together with swelling and redness. The temperature may be elevated. The treatment is adequate surgical incision, made radially from the anus, and best accomplished under general anesthesia. The abscess cavity is drained by loose vaseline gauze packing, or gutta-percha which is daily changed in diminishing amounts. Hot boric fomentations are a valuable adjunct in the treatment of this condition. The skin should be kept scrupulously clean and sponged and irrigated with boric solution after each defecation. The application of zinc oxide ointment to the skin around the wound is generally very acceptable to the patient.

7. **Fistulæ in ano** are narrow infected passages or fistulæ in the region of the anus. According to David, 80 per cent. of the cases in private practice and 60 per cent. of the cases in dispensary or charity hospital practice are of pyogenic origin. The remainder are tuberculous. They are the sequelæ of abscesses. Most commonly these fistulæ run from the rectal mucous membrane to the external skin. The internal opening is most commonly found at the mucocutaneous line on the posterior wall between the sphincter muscles. Less commonly they may be blind, internal fistulæ, which originate in the rectal mucous membrane and end blindly, or blind external fistulæ which originate on the skin and end blindly. By means of a proctoscope it may be possible to see the internal opening of the fistulæ if there be such. The internal opening may be demonstrated by the injection of methylene-blue or other fluid into the external opening, after which it may be seen flowing from the internal opening in the rectum. In some cases it will be possible to pass a blunt-pointed probe into the rectum through the fistula. Where there is no opening in the rectum, the fistula may originate from the tissues outside of it. The discharge which comes from the orifice of the fistula causes a considerable amount of itching and local irritation, and the patients urgently seek relief. The treatment of fistula in ano is surgical and in skilled hands is best carried out under local anesthesia. David[1] believes that 95 per cent. of the

[1] David, Vernon C.: Op. cit., p. 180.

non-tuberculous fistulæ in ano may be cured by observing the following general principles: "(1) Adequate drainage of pus from an ischiorectal or perirectal abscess, allowing the tissue to return to normal and sinuses to become as small as possible before radical operation for the cure of the fistula is attempted. (2) Multiple operations in extensive complicated fistulæ, which allow much of the soft parts to heal before the bowel is opened. (3) Except in the posterior raphé, both sphincters are never cut without reconstruction at the end of the operation. Where the whole body of the external sphincter is cut, except in the coccygeal extension where it is splintered and prevented from retraction, it is always best partially to suture the muscle ends. (4) Tight packing should be avoided. (5) Careful after-treatment is essential to keep the wound clean, provide adequate drainage, and insure healing of the wound from the bottom." Gant[1] says that when the fistula passes beneath the muscle it is impossible to cure it without severing the sphincter. This writer says that it is important to cut the sphincter at right angle to its fibers. He has had loss of sphincteric control in but 1 per cent. of 1000 private patients. According to Gant, incision of the fistula (the division operation; fistulotomy) is the operation of choice. David uses this method when the internal opening is on the posterior wall, but when the internal opening of the fistula is lateral, he prefers excision of fistula with reconstruction of the sphincter anus by mattress sutures. After the incision operation the wound is lightly packed with vaseline gauze, kept clean, and encouraged to heal from the bottom. At operation the course of the fistula may be followed by dissection. The dissection may be aided by the passage of a probe, or by the injection of methylene-blue, although the latter is not an unmixed blessing as it stains *all* the tissues a deep blue. The fistula must be laid wide open through the anus along its entire length. Fistulæ in ano may be extremely complicated, with multiple ramifications into the substance of the buttocks. They may be of the horseshoe type, which extends up the anus from one buttock to another. The treatment of these involved fistulæ is distinctly a major surgical procedure and will require the utmost thoroughness and skill to cause a cure.

8. **Pruritus Ani.**—Intractable itching about the anus is exceedingly annoying to the patient, and is extremely difficult, in many instances, to cure. Small ulcers of the anal canal should be anesthetized with procaine and cauterized by the actual galvanocautery. Thorough cleanliness obtained by washing with soap and water on absorbent

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[1] Gant, S. G.: Op. cit., p. 348.

cotton, especially after defecation. Hill[1] has recommended several applications, including the following:

(1)	Phenol	gr. xv
	Zinci oxidi	dram j
	Ung. aquæ rosæ	ounces ij
or		
(2)	Crude coal-tar	dram ss
	Zinci oxidi	dram j
	Petrolati	ounce j

Rolfe[2] has advocated the treatment of ionic medication. This "is a form of electrical treatment, whereby the ions of certain metallic salts, notably those of zinc, iodine, and mercury, are driven into the deeper layers of the skin by a direct current of electricity of low voltage" (Hill). x-Ray treatment is occasionally of value. It is not unusual to have this condition associated with hemorrhoids, in which case the hemorrhoid will be excised. A treatment has been suggested for the management of pruritus ani which consists of a circular incision of the anus. This incision severs the sensory nerves of this region and is thought to be useful in affecting a cure. The writer has not seen a case cured by this method. The operative methods are discussed by Vorschutz,[3] who says that they are to be considered when conservative measures, including x-ray, have been unsuccessful. Injection with 95 per cent. alcohol or with 0.5 per cent. quinine and urea hydrochloride has been recommended. Arch-like and circular incisions with and without suture have been advised. Even undermined radial incisions have been employed. Operations upon the sympathetic system have been described.

9. **Venereal Disease.**—Gonorrheal proctitis is unusual, but does rarely occur. The rectal mucus is infected by the gonococcus. The treatment consists of mild antiseptic irrigations and the application of silver salt antiseptics (argyrol; 1 : 2000 silver nitrate as an irrigation; $\frac{1}{2}$ per cent. silver nitrate as an application, etc.).

III. TUMORS

1. **Papillomata** or benign overgrowths of the rectal mucous membrane occasion pain, bleeding, and irritation in the region of the rectum. Their existence is determined by palpation or by proctoscope. They

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[1] Hill, T. C.: Proctology, Lea & Febiger, 1926, p. 210.

[2] Rolfe: Boston Med. and Surg. Jour., August, 1919; Amer. Jour. Surg., December, 1921, quoted by Hill.

[3] Vorschutz, J.: Zentralbl. f. Chir., 54, 2821, November 5, 1927.

are best removed by snare or excision and the resulting specimen should invariably be submitted to histological examination.

2. **Rectal polyps** (**fibrous polypi**) are benign pedunculated or sessile tumors arising from the rectal mucosa. According to David, their attachment is always at the mucocutaneous line. Knoflach[1] reported 2 cases in which circumscribed hyperplasia of the lymphatic tissue of the rectum caused the development of polypus formations. They may attain the size of a small egg and be quite firm in consistency. They may be multiple and are commonly seen in children. Their propensity toward hemorrhage is the principal indication for surgical treatment. With the aid of a proctoscope or a rectal speculum these rectal polypi may be cut across at the base and the bleeding point ligated or may be removed by clamp and cautery.

3. **Adenomata** originating from the rectal mucosa may attain the size of a walnut. They are predunculated tumors which may arise at any point on the rectal mucosa. They are usually accompanied by bleeding and may protrude from the anus. They may generally be drawn down and removed by clamp and cautery. Those higher up in the rectum may be fulgurated through a speculum (David). The writer has seen a case in a child who had been troubled with chronic rectal hemorrhage in which what was doubtless a rectal adenoma was extruded through the anus in the active stool. The mother of the child, seeing the protruding polyp attached by a small pedicle, grasped it and pulled it off and was then seized with no little concern because of the profuse hemorrhage following her operation. This, however, fortunately subsided spontaneously.

4. **Condylomata** are wart-like rectal excrescences in the region of the anus and may be syphilitic in origin. Their treatment has been described above (see pp. 342, 344).

5. **Mucous Cysts.**—There are cystic accumulations of mucus on the rectal mucosa. The excision of the uppermost wall of the mucous cyst will affect a prompt cure, similarly to the way in which it is accomplished in mucous cysts of the mouth.

6. **Malignant Tumors.**—Carcinoma and sarcoma of the rectum belong to the realm of major surgery.

IV. CONGENITAL AND ACQUIRED DEFORMITIES

1. **Imperforate anus** is that condition in which the infant is born with the skin completely grown across the anus, or a short distance up the anal canal so that there is no opening whatsoever. This afflic-

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[1] Knoflach, J. G.: Wien. klin. Wchnschr., 40, 876, July 7, 1927.

tion will require prompt surgical treatment. Without any anesthesia whatsoever an incision is made into the obstructing membrane, and the wound is dilated with the finger.

2. **Anorectal Stricture.**—Stricture of the anus and lower rectum may be congenital or acquired. In congenital cases the opening may be extremely small. Brennemann[1] has reported 6 cases of "infantile congenital anorectal stricture, apparently all of the simple diaphragmatic type, in which abdominal (colonic) distention was the outstanding symptom, the obstruction was promptly relieved by finger dilation." The treatment of anorectal stricture is careful and gradual dilatation of the stricture. This will be done by well-lubricated bougies, extreme care being taken not to puncture the rectal wall beyond the stricture. Where possible these dilatations should be done daily and the patient's mother, where possible, will continue the dilatation digitally. The gloved and lubricated little finger will first be inserted into the rectum and succeeding fingers used, until finally the thumb is used. Beyond this size and in some cases in the absence of digital dilatation hard-rubber rectal dilators will be used. After the dilator is passed it will be left in place for a few minutes before withdrawal. The congenital strictures may be "cut longitudinally and, after mobilization of the mucosa, sutured transversely" (David).

3. **Incontinence of Feces.**—This condition may be due either to local injury of the sphincter or to central disease or injury of the nervous system. The treatment, if any, will be major surgical.

4. **Prolapse of the Rectum (Procidentia Ani; Procidentia Recti).**—In this condition there is an abnormal descent of a portion of the rectal mucosa into the rectum or through the anus. This condition occurs more frequently in infancy and childhood, but may occur at any age. It may be an accompaniment of any condition in which there are frequent evacuations, coughing, or straining. In young children having cases of short standing a cure may often be obtained by non-operative means. Gant[2] says that he has succeeded in permanently curing procidentia ani in children under five years by "(*a*) prescribing a daily laxative or enema to prevent constipated stools and straining; (*b*) circumcising the child if troubled with phimosis; (*c*) administering soothing medicines to allay coughing and antidiarrheal remedies to diminish frequency and fluidity of the evacuations; (*d*) irrigating the rectum morning and night with a cold infusion of quassia, black oak bark, or solution of ichthyol, balsam of Peru, or alum solution, 20 grains to the

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[1] Brennemann, Joseph: Jour. Amer. Med. Assoc., 89, 662, August 27, 1927.

[2] Gant, S. G.: Op. cit., vol. ii, p. 35.

pint, to tone and pucker up the mucosa; (*e*) replacing the bowel after stool; (*f*) having the patient defecate in the recumbent posture or on the side, with the hips elevated, to diminish pressure upon the lower rectum, and (*g*) constantly keeping a pyramidal-shaped compress over the anus, held in place by a T-binder or strong adhesive straps, that pull the buttock over it, thus preventing the child from straining down, and which stimulates sphincteric contraction, and strengthens the anal outlet" (Fig. 188). The treatment must be carried out for weeks and months.

In recent cases where the bowel is merely edematous and has not become ulcerated or gangrenous, the physician will attempt to reduce the prolapse manually. "In exceptional cases general anesthesia or infiltration of the sphincter with eucaine, and stretching or dividing the muscle, is required to release the strangulated bowel. With one or two exceptions the author (Gant) has never failed to reduce prolapse in the following manner: With patient in the knee-chest posture, extruded gut is cleansed with warm boric acid, and covered with soft linen or silk smeared with oil or vaseline, then the tumor is grasped in the hollow of the hand and squeezed free of serum by even pressure made on all sides, after which the protrusion is gradually replaced by beginning at its distal extremity and working the extruded gut upward

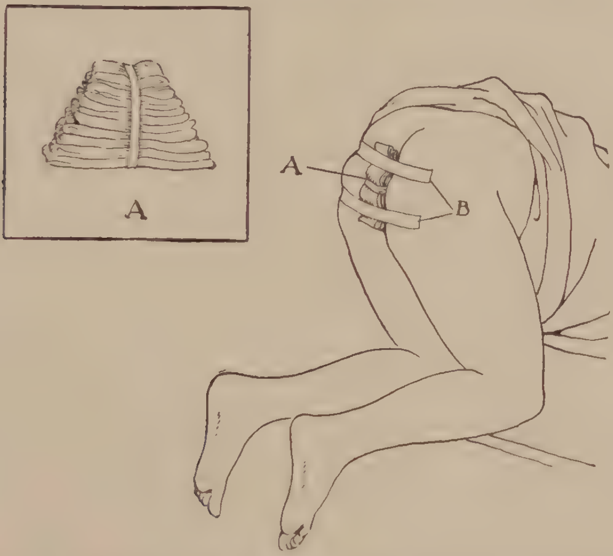

Fig. 188.—Gant's method of preventing and curing procidentia ani by supporting the anus with *A*, pyramidal compress, and *B*, firmly strapping the buttocks over it. (Gant, "Diseases of Anus, Rectum, and Colon.")

and through the sphincter with fingers separately manipulated" (Gant, loc. cit.). Rectal plugs and pessaries are sometimes of use in adults. Various surgical procedures have been advised. In the Gant local anesthesia ligature operation, various portions of the everted mucosa are ligated in little bunches under local anesthesia. The extruded bowel is then reduced. With the healing of the ligated portions, the cicatrices which result will take the slack out of the mucosa. A purse-string encircling the anus, or the excision of a circular strip of mucous membrane has been used. An operation similar to the Whitehead operation for hemorrhoids also has been employed.

5. **Hemorrhoids** (**piles**) have been defined as vascular tumors of the rectal mucous membrane. They are dilated veins in the region of the anus and lower rectum. These veins and the adjacent soft parts may become secondarily affected with chronic inflammation so as to become somewhat thickened. The size of the hemorrhoid varies with the degree of the distention of the vein. Hemorrhoids are classified as external or internal in accordance with the relationship of their attachment to the mucocutaneous line. The external hemorrhoids are external to the mucocutaneous line and are covered with skin. The internal hemorrhoids are within the mucocutaneous line and are covered with mucous membrane.

While there are numerous predisposing causes of the development of hemorrhoids, the actual mechanical cause is simply stated by Hill (loc. cit.) as "circulatory obstruction produced by pressure upon either the abdominal or rectal veins, which retards the return of venous blood to the liver, thus increasing the pressure in the hemorrhoidal zone." Small external hemorrhoids rarely give rise to symptoms, although itching may be present. The larger ones may occasion pain which is not constant, but is more marked when the hemorrhoids are swollen and is very marked when they are thrombosed.

In addition to the dilatation of the venous channel there is edema and swelling of the overlying soft parts. Such hemorrhoids are painful, particularly during and immediately after defecation. The prophylactic treatment of the milder cases of hemorrhoids consist, chiefly in strict attention to the prevention of constipation. A careful anti-constipation diet should be worked out for the patient, being careful to stress the omission of seeds and bran hulls. An ounce of mineral oil every evening will be a beneficial adjunct. Mild cases which are acutely swollen will be benefited by rest and hot or cold fomentations.

In some cases of external hemorrhoids the blood in the distended pile will become clotted and a *thrombosed hemorrhoid* will be the result.

The actual clot of blood will vary from $\frac{1}{4}$ inch in diameter to considerable size. The pain from these thrombosed hemorrhoids may be very intense and the patient will be incapacitated from work. The smaller thrombosed hemorrhoids will very frequently yield to rest and hot or cold fomentations. The larger ones will require minor surgical treatment. The hemorrhoid and adjacent region are first carefully cleansed with soap and water and the skin is then painted with an antiseptic solution, particularly mercurochrome-acetone solution. At the most prominent part of the affected pile the skin will be painted with pure carbolic acid for a circumference of $\frac{1}{8}$ of an inch. The anesthesia produced by the phenol will greatly mitigate the pain incident to the congestion of the local anesthetic solution. One-half to 1 per cent. novocaine solution will then be injected through the carbolic area *into* the skin overlying the pile. Great gentleness must be employed and pains must be taken not to exert downward pressure upon the painful thrombosed hemorrhoid. After the skin has been infiltrated over the pile, an elliptical incision will be made with a very sharp knife without great pressure. The purpose of the ellipse is to excise the small piece of skin on the convexity of the pile. This incision will be deepened until the clot is encountered and it will be surprising to note that the distance between the external surface and the interior of the hemorrhoid may be as great as $\frac{1}{4}$ inch, owing to the edematous swelling. In another method the thrombosed pile may be transfixed with a bistoury and cut outward. The clot may then be easily shelled out and the interior of the hemorrhoidal cavity is packed for twenty-four hours with iodoform or plain gauze. The wound heals by granulation. This treatment may be carried out at home or office and generally will completely cure this particular hemorrhoid and will afford the patient almost immediate relief. Hill[1] prefers infiltrating the entire thrombosed hemorrhoid, excision of an elliptical portion of skin, and the dissecting out of the clot, capsule, and overlying skin *en masse.* Catgut sutures are employed, if necessary, to close the incision. Where other piles are present or where the thrombosed pile is particularly large a regular hemorrhoid operation may be necessary.

The diagnosis of internal hemorrhoids will, of course, not be possible from external inspection. By everting the anal orifice and requesting the patient to bear down as if going to stool, the internal hemorrhoids may be brought into view. Moreover, palpation with the gloved finger will generally not appreciate the soft, compressible internal piles. The patient, however, will give a history of pain with and without defecation, of bleeding particularly at time of defecation (bright red blood), and occasionally of protrusion through the anus of the internal hemorrhoid. He may say that he has been compelled to replace an internal hemorrhoid digitally. Proctoscopic examination of the lower rectum will reveal the internal hemorrhoids, but this procedure generally is unnecessary to make a diagnosis. Mild cases of internal hemorrhoids are very often well treated without operation. The care of the diet prescribed above, strict cleanliness of the external parts, and the use of astringent ointments will greatly relieve or cure the condition. These astringent ointments are numerous and contain a wide variety of drugs. Useful ones are those which contain stramonium and nutgall, ichthyol, minute quantities of phenol, or even novocaine. These ointments are instilled into the rectum by means of a "pile pipe," which is a fenestrated nozzle which may be screwed upon a collapsible tube. The injection of the ointment is made once or twice daily, particularly after defecation. Another useful measure is the employment of astringent or analgesic suppositories.[1] Hill (loc. cit.) recommends the "injection of 1 ounce of olive oil before retiring" as one of the best palliative measures for internal piles. Hot sitz-baths are always welcomed by the patient.

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[1] Hill, T. C.: Op. cit., p. 145.

The more marked cases of both external and internal hemorrhoids will require operation. A wide variety of operations have been devised for the removal of hemorrhoids, but the principles involved are similar in all. These consist of sterilization of the operative field as far as is possible, the removal of the hemorrhoidal mass, the control of hemorrhage, and the proper after-care. In the hands of many men a hemorrhoidectomy is a relatively simple procedure, and may even be done in the office. Local anesthesia may be used to great advantage. General anesthesia, if elected, will have to be deep in order to secure relaxation, an accomplishment which is difficult owing to the sensitivity of the anal region. The patient is carefully shaved and a cleansing enema, preferably of some 8 ounces of boric solution, is given before the operation. Preoperative laxatives are contraindicated, except where a Whitehead operation is contemplated or where there has been lack of bowel movements for some time. In this case the laxative should so be administered that the lower bowel is thoroughly cleansed on the day before the operation. If one enema fails to empty the lower bowel, it should be repeated. The patient is placed in the lithotomy position and the area for some 6 to 8 inches about the anus is carefully painted with antiseptic solution, preferably mercurochrome-acetone solution. If local anesthesia is to be employed, the procedure is carried out as described above (p. 363). The sphincter ani will then be dilated. This procedure requires a certain amount of patience and skill and should not be trusted to an interne unless he is well acquainted with it. Before starting it, the anesthetist, in the case of general anesthesia, should be warned that the sphincter is about to be dilated. Dilatation of the sphincter ani is a very powerful respiratory stimulant and the excessively deep inspirations which result may occasion the inhalation of too great a quantity of the general anesthetic agent used. The gloved index-finger, which has been well lubricated, is first inserted in the rectum and the sphincter is stretched in all directions. The index-finger of the opposite hand is then inserted slowly, and the sphincter is slowly and carefully divulsed. After an appreciable interval of time a third finger is inserted, and finally a fourth. Four fingers generally constitute ample dilatation. Most authorities believe that if the sphincter is adequately dilated the postoperative pain will be much less. A bivalve rectal speculum is now placed in the rectum and the blades are spread apart. The largest internal hemorrhoid will be grasped at its most dependent portion by an Allis or hemorrhoidal clamp, and drawn centripetally into the lumen of the rectum. This will show the closest attachment to the mucocutaneous junction. A small V-shaped incision is now made in the skin immediately external to the sphincter, the apex of the V being directed outward. The incision may be extended into the rectal mucous membrane for perhaps $\frac{1}{4}$ of an inch. The skin contents of the V and the hemorrhoid itself are drawn up as one piece and with blunt dissection the pedicle of the hemorrhoid may be further dissected. From here on the procedure of Gant will generally be employed. This consists simply of the application of the base of the free pile of a strong ligature of waxed harness linen. As this ligature is drawn taut it will be well to have the assistant who is holding the clamp which grasps the hemorrhoid, push this clamp into the rectum. This procedure will facilitate the inclusion of all the pile in the ligature. Care must be taken not to include any of the sphincter ani muscle in the ligature. The ligature itself must be tied with a triple square knot. The excess of the pile beyond the ligature is now clipped off, leaving $\frac{1}{8}$ of an inch beyond the ligature so that the latter will not slip off. This procedure is repeated around the circumference of the anus, taking the main hemorrhoidal masses in three or four ligatures. The small external hemorrhoids will be clipped off with the scissors and the wounds made by the V incision will be approximated by a few interrupted catgut sutures. Campbell[1] says, "enough sutures should be used above the mucocutaneous line to assure thorough hemostasis, but below this line are not only rarely necessary, but usually contraindicated. Edema and strangulation of tissues are the immediate results, and infection later. All redundant or overlapping external skin should be trimmed away, after which the edges are held in apposition by the sphincters." A very popular operation which may be used instead of the ligature one is to clamp the base of the freed hemorrhoid with a crushing hemorrhoidal clamp. The skin and adjacent portions of the anus are then protected by a layer of wet gauze and the pile which protrudes through the clamp is burned off with the actual cautery. When the clamp is loosened the charred base will generally not bleed, but if it does the bleeding point should be recauterized or clamped and ligated. As a further preventative of hemorrhage some surgeons make a running suture over the hemorrhoidal clamp after the pile has been removed by the cautery and when the clamp is removed pull this running suture up snug and tie it. At the completion of the operation it has been the custom of some surgeons to insert into the rectum a large rubber tube covered with vaseline gauze. This tube has been termed a "whistle," and should, as Binnie says, be reserved for one's worst enemies and for well-known malefactors. All that is required is a thin strip of vaseline gauze, which acts as a slight hemostatic agent against the small amount of oozing which may occur. Hill and David prefer to use no gauze at all. An opium and belladonna suppository may now be inserted and a sterile gauze compress be held snugly in place by a T-binder. Perhaps preferable to the T-binder is the rectal binder of Montague.[2] This consists of an elastic belt provided with four clasps to which are attached, with whatever tension is desired, four tapes holding a cotton pad (see Fig. 189). The

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[1] The "Anusol" suppository of Schering and Glatz is commendable.

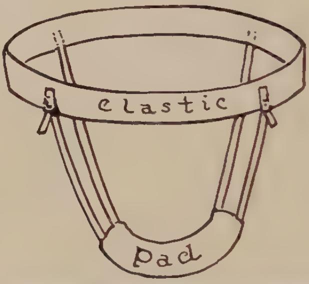

Fig. 189.—Perineal dressing consisting of an elastic belt supporting a sanitary pad to which are attached four tapes. (Montague, J. F., Jour. Amer. Med. Assoc., July 3, 1926.)

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[1] Campbell, F. B.: Jour. Kansas Med. Soc., 28, 164, May, 1928.

[2] Montague, J. F.: Jour. Amer. Med. Assoc., July 3, 1926.

postoperative care of a hemorrhoidectomy will vary widely with the surgeon. A useful routine is to have a sterile boric external irrigation twice daily and after every defecation and in the female after every urination. Continuous hot boric fomentations to the perineum will be greatly appreciated by the patient. Morphine should be given for the pain. Ordinary light diet may be started as soon as the effect of the anesthesia has worn off, of course, omitting seeds and bran hulls. An ounce of mineral oil will be given every night. On the second day postoperatively, or whenever the patient feels a desire to defecate, a retention enema of 3 to 4 ounces of sterile albolene or olive oil or an enema of 2 ounces of oil and 1 pint of water will be given by means of a small, soft-rubber catheter. The attendant will be instructed to be sure to place this catheter *in* the anus and be warned against clumsy efforts to force it in the sulci which are present at the margin of the anus after the operation. After the enema defecation follows, if not, the enema should be repeated on the third day and, if this is not successful, a low-pressure soap-suds enema may be required. After defecation the anus and adjacent parts should be washed with warm soap and water by means of a soft sponge and the skin about the anus should be coated with zinc-oxide ointment. Occasionally tender granulating protrusions will be seen and felt by the patient in the neighborhood of the anus. These may be touched with a drop of pure phenol or of silver nitrate. In cases which are unduly sensitive or in which there is a concomitant mucous colitis, it will be very difficult to secure the comfort of the patient. Local applications of $\frac{1}{2}$ to 1 per cent. silver nitrate solution, supplemented by hot boric fomentations, will be useful. In all operations for hemorrhoids it must be remembered that the field should be made as sterile as possible and despite the presence of colon bacilli in the dejecta, extreme cleanliness must

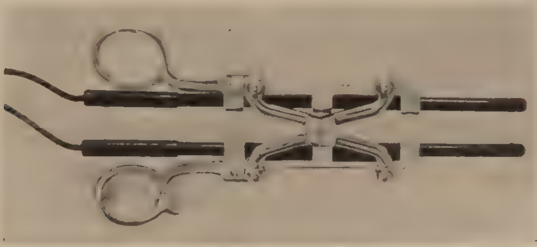

Fig. 190.—Type of electrode for removing hemorrhoids by the high-frequency current. (Bierman, William, Amer. Jour. Surg., June, 1927, Paul B. Hoeber, Inc., Publishers, N. Y.)

be carried out. Cases have been reported where there has been infection transmitted to the hemorrhoidal veins, to the portal vein with subsequent fatal abscesses of the liver. The patient is allowed up on the second to third day and may leave the hospital, in most cases, about five days after the operation. Enemata should be continued for two weeks after the operation (David). The operative field should be cleansed with soap and water twice daily.

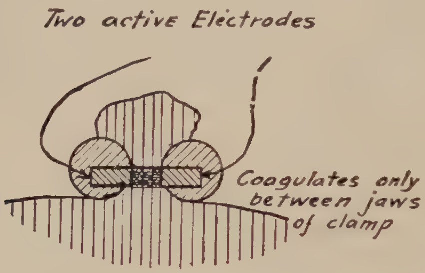

Fig. 191.—Method of applying electrode for the removal of hemorrhoids by the high-frequency current. (Bierman, William, Amer. Jour. Surg., June, 1927, Paul B. Hoeber, Inc., Publishers, N. Y.)

Bierman[1] has described a method of operating upon hemorrhoids by the high-frequency current. His special clamp with electrodes is shown in Fig. 190. It is applied to the hemorrhoid in the manner shown in Fig. 191.

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[1] Bierman, William: Amer. Jour. Surg., June, 1927.

CHAPTER XVIII

INJURIES OF THE UPPER EXTREMITIES

1. **Contusions, blisters** and **abrasions** have been dealt with in the section on Wounds and rules for their treatment as described there will be carried out. Likewise, the treatment of *hematoma* will be the same. By the term *blood blister* is meant a small effusion of blood between the layers of the epidermis. This is at first swollen and painful. It should not be opened, but should rather be guarded from traumatism. The swelling will subside and the blood gradually absorb until nothing remains but a small dark-colored plaque. The epidermis overlying this plaque will finally scale off and normal skin will be found underneath.

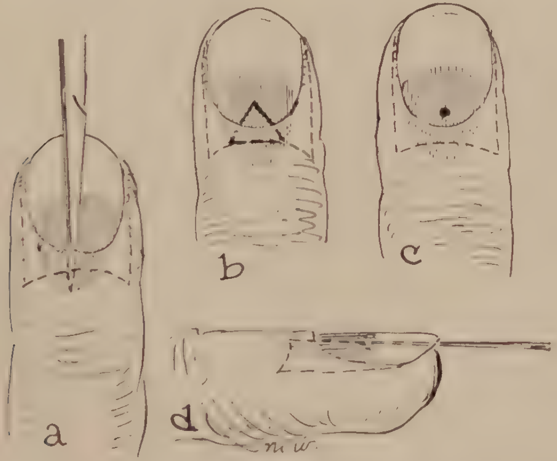

Fig. 192.—Methods of decompression of a subungual hematoma: *a*, Sharp-pointed scalpel lifts eponychium away from the base of the nail. *b*, V-shaped piece excised from the base of the nail. *c*, Small hole drilled through the nail. *d*, Needle inserted under the nail from the distal end.

Contusions of the finger-tips are extremely common and will often cause an effusion of blood beneath the finger-nail. This is spoken of as a *subungual hematoma*. This condition may be extremely painful. In the smaller hematomata of this type the treatment will be symptomatic; elevation, hot and cold compresses will be tried. Where the effusion is large, and where the pain is very intense, it will be necessary to release the imprisoned blood. This is done under strict antiseptic precautions and by a variety of methods (Fig. 192). A useful method is to trephine the nail. This is done by taking a sharp scalpel and with a drilling motion, with as little pressure as possible, a hole is bored through the nail and the blood is allowed to escape. Other methods include the excision of a V-shaped piece of nail at the base and the forcing of a needle underneath the entire nail, beginning with the tip. In all cases after the release of the blood a sterile dressing should be applied.

2. **Incised wounds, lacerated wounds, puncture wounds,** and **gunshot wounds** should be treated in the manner described in the section on Wounds. Crushing and mangling injuries of the arm and forearm, which may require amputation, are subjects of major surgery. The less extensive wounds may require the Carrel-Dakin treatment as previously described.

Wounds by Aniline Pencils.—Wounds caused by aniline pencils must be given careful consideration. They commonly occur upon the fingers and hands of typists. Iselin[1] says that these wounds must promptly be taken care of by a radical extirpation of foreign body and the tissue around it, as the periphery of the wound is a source of further pathological process. No attempt should be made to remove the particle with forceps.

Milch[2] states that the solution of the aniline dyes in the tissue juices produces an aseptic necrosis which develops slowly and is apt to be extensive. This author says that as attempts to remove the offending body may break it into smaller fragments, injure the protective wall about it, and open the tissue spaces, the rational treatment is wide excision of the wound and the contained foreign body at the earliest possible moment.

Defects of the Palmar Surface of Fingers.—Where the wound has caused a defect in the palmar surface of a finger the ingenious method of Gatewood[3] which obviates hospitalization may be utilized. This operation is carried out under 0.5 per cent. procaine and the method of procedure is graphically given in the accompanying illustration (Fig. 193) from Gatewood's article. The surface of the palmar defect is carefully prepared. The finger is sharply flexed and a pedicle flap of the palmar skin is reflected so that the under surface of the flap will easily correspond with the defect. After careful suture of the flap to the defect the flap wound is approximated.

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[1] Iselin, Marc: Presse Méd., 35, 467, April 13, 1927.

[2] Milch, H.: Ann. Surg., 1928, 87, 95.

[3] Gatewood, Jour. Amer. Med. Assoc., October 30, 1926.

Finger-tip Injuries.—Severe injuries to the finger-tips are not uncommon. In cases with ill-advised treatment there may result the sequestration of a portion of the distal phalanx or the formation of a painful scar. To obviate these possibilities, either sufficient bone may be removed to permit the skin to be approximated without tension, or a flap of skin may be transplanted from some other part of the body. The former course is the easier, but entails the loss of some of the valuable finger. The latter course is more difficult, and is a problem of major plastic surgery. Krecke[1] recently treated 4 cases by pedunculated abdominal flaps with success,

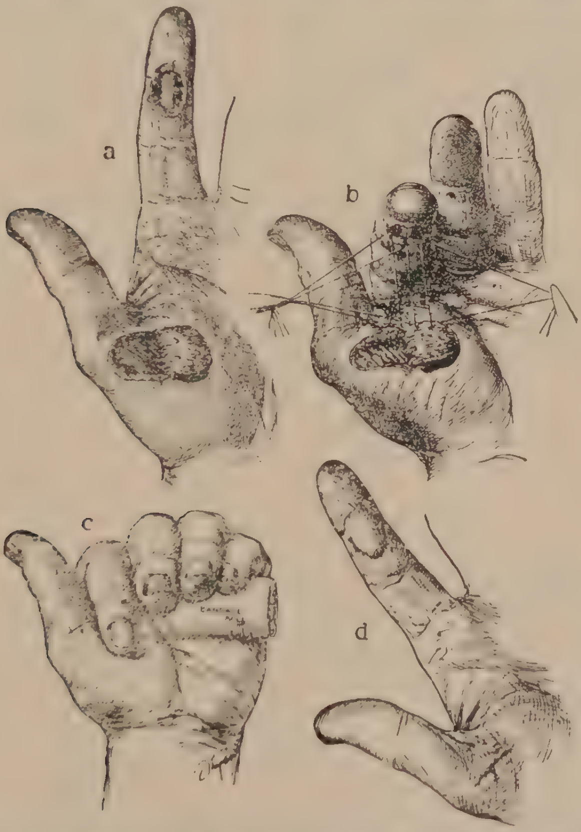

Fig. 193.—Steps in an operation for the plastic repair of finger defects without hospitalization. (Gatewood, Jour. Amer. Med. Assoc., October 30, 1926.)

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[1] Krecke, A.: Münch. med. Wchnschr., 75, 571, March 30, 1928.

but in 1 case in which free transplantation was tried the result was unsuccessful.

3. **Traumatic Amputation of the Fingers.**—Injuries to the fingers are very common in industry and may be very extensive. All or portions of the fingers may be traumatically amputated or the crushing may be so severe as to require amputation. While it will be desirable to maintain as much length of finger as is possible, it is important that the bone be removed sufficiently so that ample skin may cover the end. For the revision of a traumatic amputation of the fingers *local anesthesia* may be employed. The technic of the production of local anesthesia in fingers is described by de Takáts'[1] as follows: "At the base of the finger, the three pairs of small nerves that innervate the entire finger run in the subcutaneous tissue. A fine hypodermic needle is inserted at the base of the finger on the lateral side, closer to the dorsal surface (Fig. 194). Not more than 1 to 2 c.c. of a 2 per cent. novocaine-adrenalin solution are injected on each side, the dorsal side getting a little less than the volar. Ultimately, not more than 3 to 4 c.c. of a 2 per cent. solution are used. The anesthesia of the

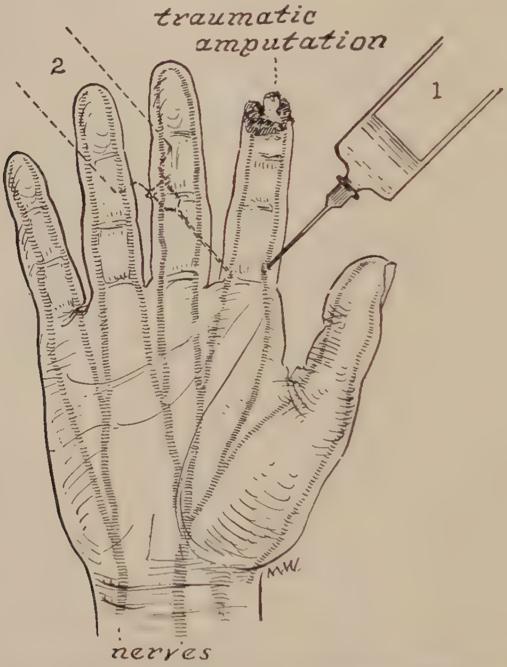

Fig. 194.—Nerve-block anesthesia in the treatment of finger-tip injuries.

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[1] de Takáts, Geza: Local Anesthesia, W. B. Saunders Co., 1928, p. 185.

whole finger begins in from five to ten minutes and lasts from two to three hours. Untoward symptoms, such as severe after-pain, swelling of the finger, and chronic edema, have been seen if large quantities, such as 10 to 15 c.c. of a 0.5 per cent. solution, are used. With the above technic there are no such symptoms. The adrenalin should never exceed 10 drops of 1 : 1000 solution to 100 c.c., the finger arteries being practically end-arteries." The use of a rubber tourniquet at the base of the finger is painful and, according to de Takáts, is unnecessary. In many cases, however, it will be necessary to use general anesthesia. The skin will be carefully cleansed with soap and water and all débris and dirt removed from the wound. If grease be present it may be removed by benzene. The wound and adjacent skin is then liberally painted with an antiseptic solution, 7 per cent. tincture of iodine, mercurochrome-acetone solution, or 1 : 2000 metaphen solution. The ragged and devitalized skin edges are then trimmed off. Careful thought should be given to the best manner of planning the flaps. A long palmar flap, so that the suture line is on the dorsum of the finger is always best, if possible, as a tender scar on the palmar surface of the finger may be the cause of great subsequent annoyance (Fig. 195). Orr[1] says, "The tendons of the finger are sutured together over the bone end or attached to the periosteum. Careful section of the bone with bone-cutting forceps or small saw will avoid

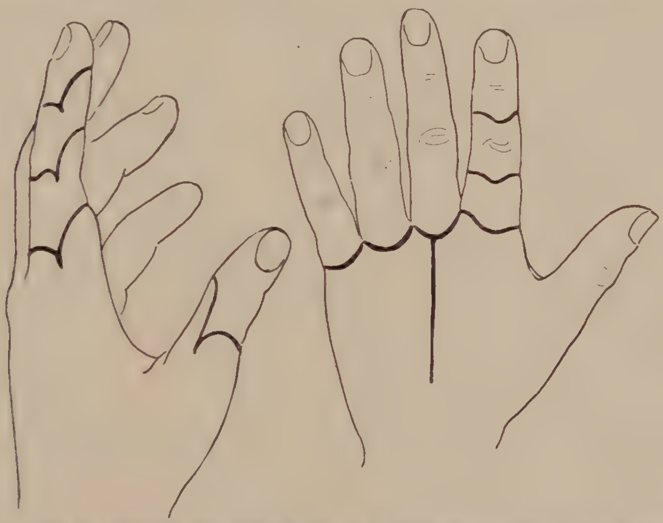

Fig. 195.—Lines of incision for amputations of fingers and thumb. (After Orr, T. G., Modern Methods of Amputation, C. V. Mosby Co., Publishers.)

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[1] Orr, T. G.: Modern Methods of Amputation, C. V. Mosby Co., 1926, p. 35.

bone splintering and delay in healing. The periosteum is carefully trimmed from the bone and removed for a millimeter or two from the bone end. Such treatment will reduce sensitiveness of the stump. If a good palmar flap is used it is hardly necessary to attempt to cover the bone-end with other tissue since such a flap will furnish sufficient padding. . . . Length of bone should not always be sacrificed to obtain perfect flaps. Sometimes what appears to be a very rough piece of surgical work will produce a fairly good functional result." In some cases it will, of course, be impossible to suture the tendon ends together. The fine saw is preferable to the bone-crushing forceps. The skin edges are loosely sutured with a few interrupted silk sutures. If a tourniquet has been employed, it is now removed and if a spurting vessel is disclosed it will be clamped and ligated. When once assured that hemostasis has been effected, a dry gauze dressing will be applied. Wet dressings are inadvisable. A tongue-depressor splint will be fastened to the outer part of the dressing so that it projects $\frac{1}{2}$ inch beyond the finger-tip for protection (Fig. 196). Unless there be throbbing and increased pain which may be interpreted as evidence of infection the dressing will not have to be changed for forty-eight hours. The removal of the dry and adherent gauze will be facilitated by soaking the finger and bandage in a vessel of sterile warm boric solution or hydrogen peroxide solution. These wounds practically all become secondarily infected, in which case the dressing will be done daily and warm boric dressing may be required. The stitches are removed on the sixth to the tenth day.

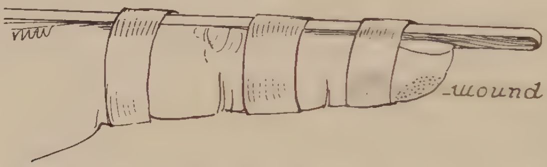

Fig. 196.—Tongue-depressor splint arranged to protect wounded finger-tip.

Finger-tip Injuries.—These injuries deserve special mention. Special care must be taken for the preservation of asepsis, and the application of antiseptic solutions. The wound should *not* be tightly sutured, and should be dressed dry. Fractures of the distal phalanx are liable to infection because of the anatomical considerations and the fact that virtually all of them are compound. If not compound at the time of the original injury, they generally become so because of the formation and subsequent liberation of a subungual hematoma. (See section on Infection, also section on Fractures of the Phalanges.)

4. **"Auto-door Finger."**—The recent great usage of automobiles has made the pinching of fingers in the slammed doors of automobiles a very common ailment. This occurs particularly in children, and is generally accompanied by some subungual hematoma. This will be treated as described above. Very often all or part of the base of the nail is found to be protruding above the eponychium.

In this event the loosened base of the nail is cut off, leaving the distal attached portion in place (Fig. 197). It is well to be sure that *all* of the base of the nail is removed if this is done. The lifting up of the nail corner is facilitated by a small hook. It is well in all cases of "auto-door" finger to take an *x*-ray of the distal phalanx. This can conveniently be done with a dental film. A linear or comminuted fracture will often be disclosed. The fragments are rarely out of position. These painful fingers are best treated by the use of first cold applications and later hot applications. Mock and Ellis[1] advise the incision of these very painful fingers. If there be a subungual hematoma it is thus relieved. If no hemorrhage appear beneath the nail, an "alligator mouth" incision is made through the theca $\frac{1}{8}$ inch below the nail and across the full width of the finger back to the injury. The author believes that this procedure will be but infrequently necessary and has the disadvantage of converting a simple fracture into a compound one. Nitrous oxide or ethylene is preferable to local anesthesia for incision of finger-tips. If local anesthesia be used, the nerve block is preferable to infiltration. The tongue depressor will be loosely bandaged to the affected finger. Early motion, that is, beginning on the third to sixth day, is to be insisted upon. The patient should be warned that the tenderness may persist for seven to twenty days.

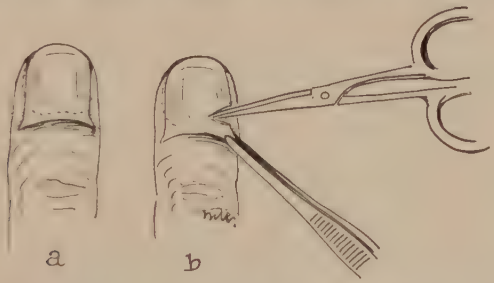

Fig. 197.—*a*, Extrusion of nail root following contusion of finger. *b*, Resection of extruded nail root.

5. **Wounds of Tendons.**—Rarely tendons are ruptured by overstretching. Commonly they are severed by sharp instruments. In all

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[1] Mock, Harry E., and Ellis, John D.: Surg., Gynec., and Obst., October, 1927, p. 551.

wounds of the fingers, hands, and forearms which penetrate beneath the skin, tests should be made to establish the presence or absence of continuity of the tendon. No matter how painful the wound is or how reluctant the patient is to attempt it, flexion and extension of the fingers and hand should be demanded. If there be limitation of the motion of the fingers or hand, tendon injury will be evident. One should be on particular watch in wounds of the palmar surface of the fingers or hand that flexion at the distal interphalangeal joint is not interferred with. If there is inability to flex the distal phalanx, the diagnosis of section of the flexor digitorum profundus may be made.

Knife wounds which have cut all or nearly all of the tendons at the wrist will require such formidable surgical treatment as to classify it as a major surgical procedure. Section of tendons of the fingers, while of serious moment, may yet be considered in the realm of minor surgery. The operation of tenorrhaphy will best be carried out under general anesthesia. Elaborate precautions must be taken to insure asepsis. The entire hand will be painted with antiseptic solution, preferably 7 per cent. iodine, before being draped with the sterile linen. General anesthesia will be preferable, and a good light and adequate assistants are indispensable. It may be very difficult to locate the severed ends and not infrequently it is necessary to make an incision up the tendon sheath to secure the proximal retracted end. This procedure, however, is undesirable and every effort should be made to cause the proximal end of the tendon to protrude from the wound by milking the tendon down by external pressure and by acutely flexing or extending the fingers or hand as may be indicated. Moser[1] has described a method of artificial muscle relaxation by the employment of local anesthesia. This injected into the muscle substance produces a lengthening of the muscle and makes the central tendon stump more accessible. Great gentleness must be employed in handling of the tendon. Hemostats must grasp only the extreme distal cut ends. The delicate epitenon must not be traumatized any more than is absolutely necessary. The methods of approximating the cut ends will best be carried out after the teachings of Bunnell. It will be very important to be sure that in the cases where several tendons are cut, the severed ends of the tendons are properly matched up. It will be perhaps needless to warn against the danger of mistaking a nerve for a tendon. Bunnell[2] gives the following method of uniting tendons end to end without traumatizing the delicate epitenon. Bunnell's illustrations are herewith reproduced

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[1] Moser, E.: Zentralbl. f. Chirurgie, 54, 1606, June 25, 1927.

[2] Bunnell, Sterling: Jour. Bone and Joint Surg., January, 1928.

(Fig. 198). "As shown in *A*, with the tendon held taut by a Kocher hemostat, one of the two needles is passed through it diagonally, starting about 1 cm. back. Three similar stitches in all are taken with this needle. At each the needle re-enters the tendon a short transverse distance from where it emerged and finally the needle emerges 2 or 3 mm. from the hemostat, but on the opposite side of the tendon from where it first entered. In *B* is shown the other needle starting its first stitch transversely across the tendon, entering only a few fibers transversely away from where the first needle entered. (Reversed in the diagram.) With this needle three diagonal stitches are then taken, just as with the first needle, emerging from the tendon directly opposite where the first needle emerged. The traumatized cicatricial tip of the tendon is snipped off, as in *C*, and in the insert the stitch is shown as it will be when finally placed. In *D* while the tendon is held taut over the finger by one suture, the other suture is passed back

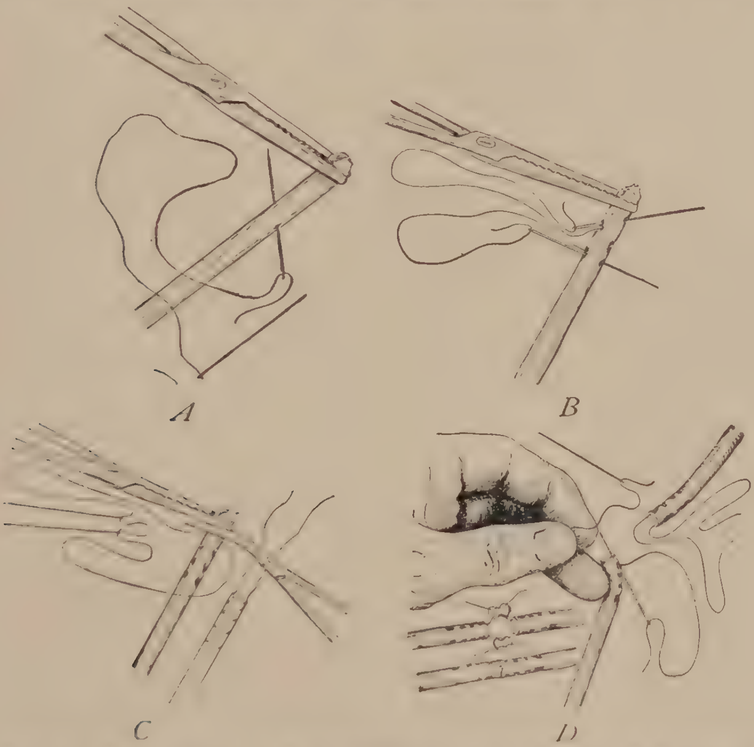

Fig. 198.—Tenorrhaphy: *A*, Tendon grasped and suture started. *B*, Further steps in suture. *C*, Traumatized end of suture cut off. *D*, Method of making end-to-end attachment of tendon ends. (See text.) (Bunnell, Sterling, Jour. Bone and Joint Surg., January, 1928.)

through the point where it emerged and is made to emerge from the end of the tendon on that same side. Each suture is then pulled firmly to remove all slack and is tied to the suture opposite it, which emerges from the end of the other tendon, and the result is as shown in the insert." Baumann[1] makes an end-to-end suture with no more than two (usually one) twisted or silk sutures. The cutaneous wounds should, if possible, be made arch shaped so that the cutaneous wound does not lie immediately over the tendon suture. Baumann advises heat, exercise, and light massage after two weeks with guarding against overextension for another week.[2]

After the wound has been closed with interrupted sutures it is important to put up the extremity in such a position as to exert the minimum amount of tension upon the sutured ends of the tendon. In cases of the flexor tendons the hand and fingers will be put in flexion and held in that position by a molded plaster splint. In cases of the extensor tendons the position will be that of extension. As a general rule, the extremity will not be moved for a period of three or four weeks, when massage, external heat, and active motion will be instituted. Gentle passive motion will follow. On the other hand, Dowden[3] says that cut tendons should be so sutured that they will withstand early movement, and that after twenty-four hours the patient should be asked to move the affected member very gently several times daily, and each day the range and force of motion should be increased. For a week or two, however, care must be taken not to place any strain on the tendons. Garlock[4] made experiments on dogs in an attempt to determine when it is safe to begin motion following tenorrhaphy. This worker concluded that it is safe to institute active motion on the fifth day after operation and to remove retention apparatus on the eighteenth day. He believes that free tendon grafts inserted to bridge a defect in the tendon continue to live as such, and that it is safe to begin active motion in these cases about the tenth day, while retentive apparatus can be dispensed with on the twenty-fifth day. He states that after tenorrhaphy the return of the function is dependent upon several factors, the most important being the breaking away of the tendon from its surrounding tendon sheath, but the final outcome may not be evident for three or four months after the operation. Prati[5] has called attention to the fact that the

[1] Baumann, E.: Zentralbl. f. Chir., 53, 3037, November 27, 1926.

[2] Grege, A.: Zentralbl. f. Chir., 54, 1487, June 11, 1927.

[3] Dowden, J. W.: Internat. Jour. Med. and Surg., 1928, 41, 221.

[4] Garlock, J. H.: Ann. Surg., 85, 92, 1927.

[5] Prati, M.: Arch. ital. di chir., 1927, 17, 597.

"juncturæ tendinum" may partially, at least, assume the function of a cut extensor tendon of the hand. Section of the ring or middle finger tendons in the middle or upper third of the metacarpal need not cause limitation of extension of all of the fingers together, but only of extension of the injured finger alone. A study of the regeneration of tendons has been made by Dittrich[1]: "From histological studies he has come to the conclusion that the inner and outer linings of the tendon take part in the regeneration. Function, he believes, has less influence on the origin of the germinal tissue than on the continued differentiation and organization of the regenerating tissue. Too early and too prolonged movement may cause overproduction of callus, but when function is begun too late, the differentiation of the tissue is hindered. The best time for the beginning of function is the fourteenth day after the injury.

6. **Wounds of Blood-vessels.**—It is not in the province of minor surgery to detail the methods of vessel suture anastomosis. Minor accidents to large veins, however, might be referred to. In the operation for inguinal hernia the femoral vein may be inadvertently injured by a needle which has passed too deeply through Poupart's ligament. When this distressing accident occurs it will be necessary to reflect the upper border of Poupart's ligament inward, in order to afford access to the injured vein. If the injury be slight, grasping of the wound with the hemostat and careful ligature with a very fine piece of catgut will stop the leakage of blood without interfering with the patency of the vein.

7. **Wounds of Nerves.**—Under minor surgery the first-aid treatment of nerve wounds only will be considered. In freshly lacerated wounds of the wrist and forearm in which the severed ends of the nerve may be identified, it will be proper at the time of the first repair of the wound to approximate the cut edges of the nerve. This will be done by very minute sutures of plain or chromic catgut which are passed by very fine needles through the epineurium so as to produce an end-to-end approximation. The portion of the nerve distal to the section will then be centrifugally regenerated over a considerable period of time. If the suture of cut nerves be neglected at the time of the original operation, the secondary suture will be far more difficult because of the presence of confusing scar tissue and the services of a neuro-surgeon will generally be required.

8. **Wounds of Muscles.**—(*a*) *Closed wounds* of muscles consist of strains and ruptures. A *strain* is an overstretching of a muscle and

[1] Dittrich, K. von: Arch. für orthop. u. Unfall-Chir., 1927, 25, 382.

may result in the parting of the individual fibers of that muscle or in the actual rupture of large muscle bundles, the latter, however, being rare. The parting of one or several muscle-fibers is accompanied by local minute hemorrhage, by extreme tenderness at the site of the rupture, and by a slowly developing superficial ecchymosis. The diagnosis is made by the history of violent exertion, coupled with sudden localized pain and the finding of localized tenderness. Where the pain is very severe it will be wise to elevate the extremity and apply hot fomentations, but this procedure should not be persisted in any longer than is necessary. Early mobilization is the proper treatment of strains. A specific example of strain is "*tennis leg*."[1]

Major ruptures of muscles, as, for example, rupture of the biceps cubiti, will require major surgical treatment with an open operation, including approximation of the divided ends with mattress-sutures.

(*b*) *Open Wounds.*—Extensive lacerated wounds will occasionally involve the muscle bellies. The laceration may be extreme and accompanied by considerable herniation of the muscle belly from its facial envelope. It will be necessary to make an attempt to restore the continuity of these injured muscles. This will be done by the introduction of a *few* mattress-sutures. Too zealous efforts to make the approximation anatomically correct may only favor the development of secondary infection. These traumatic wounds are best thoroughly drained and, in cases where there is considerable introduction of dirt and the edges of the wounded muscle are jagged and devitalized, it will be better to débride and institute Carrel-Dakin treatment. Traumatic wounds involving muscles should never be closed without drainage.

9. **Wounds of joints** are far less common in the upper extremity than in the lower because of the extreme frequency of involvement of the knee. The guiding principle in the treatment of all joint wounds is the closure of the joint capsule without drainage. Where there has been introduction of considerable dirt or infected material, a proper preliminary to the joint closure will be the irrigation of the joint with a very mild antiseptic solution, as warm boric solution. This will remove the blood-clots and gross dirt. Ragged bone or cartilage will be curetted or chiseled out. The joint capsule should then be tightly closed with a continuous suture of catgut. The soft parts overlying the joint wound will then be approximated with interrupted stitches and will be drained down to the joint with rubber tissue or rubber drains. In the more contaminated cases the wound may be left en-

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[1] Christopher, Frederick: Early Mobilization in "Tennis Leg," Med. Jour. and Record, June 1, 1927, pp. 125, 731.

tirely open down to the sutured joint capsule, or merely loosely approximated. Early mobilization of the wounded joint will be encouraged and demanded, the active motion being more important than the passive motion. When the external wound has healed if the joint be still somewhat stiff, the active motion may be supplemented by passive motion, massage, hot fomentations, and diathermy. Baking with a radiant heat is somewhat beneficial.

10. **Foreign Bodies.**—The common foreign bodies found in the upper extremities are fragments of glass, splinters, sewing needles, and various missiles. Their removal will be effected by the methods detailed in the section on Foreign Bodies.

11. **Sprains** may be defined as wrenches of joints. In wrenches of joints there will be an overstretching of the joint capsule or of the various supporting joint ligaments or tendons, both inside and outside of the joint. In the milder cases or strains there is but a microscopical overstretching of these structures and but a few individiual fibers are injured. From these lesser injuries all grades of traumatism will be encountered up to complete lacerations of the joint ligaments with abnormal mobility and partial luxation of the joint itself.

By the term "sprain" is meant those injuries which involve minute traumatism only, as the rupture of individual fibers. By the term "torn ligaments" is meant the more severe injuries with abnormal mobility of the joint.

A sprain is often accompanied by a traumatic synovitis; the synovia secrete an excessive amount of fluid and the joint capsule becomes painfully distended with fluid. The shoulder, elbow, and wrist are less liable to fluid accumulation than is the knee. In sprains there is a very definitely localized pain in the joint vicinity which is occasioned by certain motions. "The pain is caused by active contraction against resistance, or passive stretching of a muscle, or a certain group of muscles or ligaments. There is a tender spot, perhaps not larger than a nickel, at the attachment of a tendon, and a small swelling with a suggestion of edema or fluid may be palpated deep down on the surface of the bone. This tender spot which is the key to the diagnosis, is a small patch of effusion below the periosteum, or in the fibers of the tendon attached to the bone constituting the origin or insertion of the muscle. The pain is due to tension on this effusion by pressure on the muscle or by direct pressure on the edematous spot.[1] There is often swelling of the subcutaneous tissues. In the lesser sprains elevation and cold applications will facilitate this absorption and mitigate the pain. The joint should be bandaged, or strapped with adhesive plaster, in such a position as best will secure the approximation of the injured fibers. A pad strapped over the tendon above the sprain will often be an effective splint of the injured part. Once the injured part has been splinted, active motion is to be encouraged provided this is not painful. The more severe sprains with joint effusions may be treated, as has been pointed out by McWilliams[1] by repeated aspirations of the joint and by early mobilization. The aspiration of the joint will be carried out with strictest attention to asepsis. The skin will be painted with 7 per cent. tincture of iodine and the aspirating needle will carefully be introduced into the distended joint capsule. The removal of the excess fluid will greatly relieve the patient's sufferings. Very severe wrenches of joints may cause the effusion of blood into the joint, a condition known as hemarthrosis. Its treatment will be identical with that of the serous effusions and include early aspirations.

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[1] McWilliams, Clarence A.: Lewis, Practice of Surgery, vol. ii, chap. 5, p. 41.

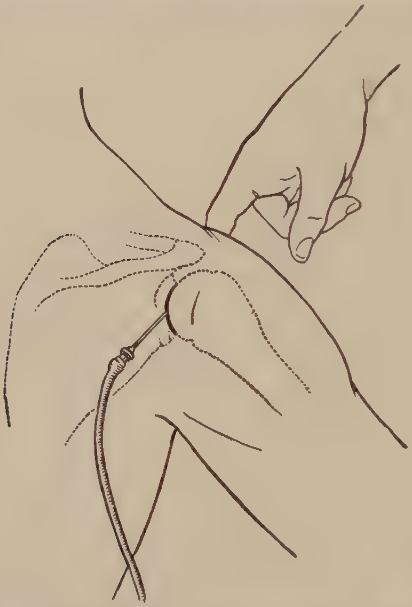

Fig. 199.—Posterior puncture of the shoulder-joint. The needle is inserted just distal to the base of the acromion between the posterior border of the deltoid and the tendon of the infraspinatus. The finger is on the coracoid process in front. (McWilliams, C. A., Lewis' Practice of Surgery, W. F. Prior Co., Inc., Publishers.)

The commoner sprains of the upper extremity are those involving joints of the fingers, the wrist, and the elbow. Owing to its extreme mobility the shoulder is practically never sprained. The joints of the upper extremity will rarely require aspiration as a treatment for sprains. This treatment is most frequently applied to the knee, and less so to the ankle-joint. Where aspiration of the shoulder-joint is indicated it is done by inserting the needle just distal to the base of the acromion between the posterior border of the deltoid and the tendon of the infraspinatus (McWilliams—see Fig. 199). The finger is on the coracoid process in front. After the maximum amount of joint effusion has been reached and the process is subsiding, warm applications will be acceptable to the patient. A very satisfactory early treatment of sprains of the fingers and wrist is a form of contrast baths. The affected joint is immersed in water as hot as may be tolerated for a period of four or five minutes, and then is plunged into cool or cold water for a period of thirty seconds to one minute. This procedure is continued for a period of fifteen to thirty minutes and is repeated several times daily. It must be pointed out that a good part of the swelling which occurs in sprains is due to an extra-articular effusion as well as to the intra-articular effusion. It is the extra-articular effusion which particularly is susceptible to treatment by contrast baths and later gentle massage. Early careful active mobilization is indicated. In cases where the injury to the joint has been so marked as to cause abnormal mobility of the joint, the treatment will involve prolonged immobilization to secure the proper union of the torn ligaments and capsule. A measure advocated by some in the treatment of sprains is the application of a snugly applied pad upon the area of effusion. x-Ray examination should always be made in all cases where there is considerable pain and

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[1] McWilliams, Clarence A.: Lewis, Practice of Surgery, vol. ii, chap. 5, p. 8.

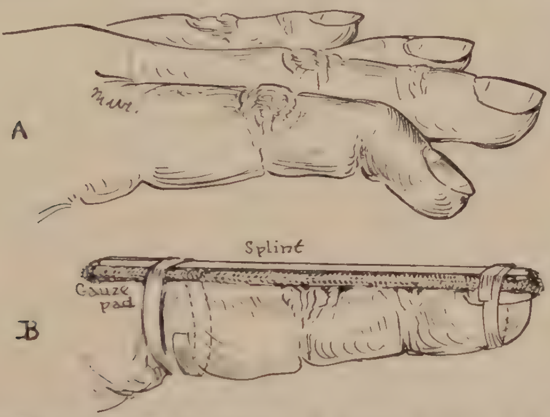

Fig. 200.—"Drop-finger." A, Rupture of digital extensor at distal phalangeal articulation. B, Treatment of "drop-finger" by dorsal padded splint. Four to six weeks' continuous immobilization will be required.

swelling or in the milder cases in which the symptoms do not rapidly subside.

12. **"Drop-finger" (Mallet Finger; Baseball Finger).**—Blows upon the tip of the extended finger, as is frequently caused by baseballs, bring about the condition known as "drop-finger." In this injury there is a rupture of the dorsal surface of the distal interphalangeal ligaments, as well as the prolongation and insertion of the extensor tendon. As a result the patient will be unable to extend the distal phalanx, which is, therefore, dropped or flexed with an annoying disability (Fig. 200, A). The treatment of this condition is apt to be somewhat difficult and prolonged. The choice of therapeutic measures is the application of a short splint, or operation. A dorsal tongue-depressor splint, holding the finger in extreme extension, may be used (see Fig. 200, B), but the improved splint of Lewin[1] is preferable. The splint with its application is shown in Fig. 201. Another extension splint is that of Siebrandt (Fig. 202). Flexion of the finger will not be permitted for a period of from four to six weeks, or longer. When

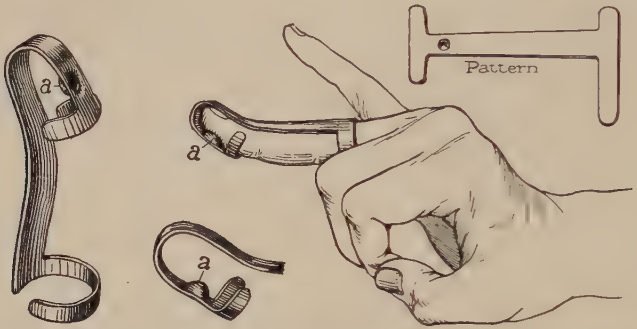

Fig. 201.—Lewin's improved splint for "drop-finger" (baseball finger). (Lewin, Philip, Jour. Amer. Med. Assoc., June 30, 1928.)

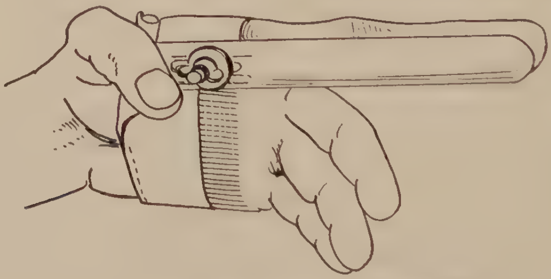

Fig. 202.—Extension finger splint. (Siebrandt Mfg. Co.)

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[1] Lewin, Philip: Jour. Amer. Med. Assoc., 90, 2102, June 30, 1928.

the splint is to be changed because it is too soiled or the finger must be washed, even momentary flexion of the distal phalanx should not be permitted, but it should be held in an extended position. The operative treatment of this injury has not been so successful as heartily to warrant its endorsement. There is no periosteum to which the tendon can be joined, and often the bony insertion of the latter is torn off. The ends of the extensor tendon are extremely frayed and the introduction of sutures into them is extremely difficult and unsatisfactory. The overlying skin at this area is so thin and the catgut knots so relatively large that infection is more likely to occur. According to Kirchenberger[1] there were but 10 recorded cases up to 1926. This paucity of reports is misleading as the condition is of very common occurrence. Kirchenberger's case was treated by dorsal splintage.

13. **Traumatic Synovitis.**—Contusions of joints, sprains, ruptured ligaments, fractures may be the cause of traumatic synovitis. The reaction of the synovia to the injury is the production of an excessive amount of synovial fluid. According to McWilliams,[2] the synovial membranes have no stomata, and hence have but very slow absorption of fluid or blood. The acute distention of the joint causes great pain, especially upon moving. The treatment of this condition will be repeated aspirations as often as the fluid forms, and *early mobilization* by *active, not passive movements.* The aspirations are carried out in the manner previously described under sprains. In this condition there is an inflammation of the tendons and sheaths which is non-microbic in character. The repeated small injuries caused by overuse of a gliding mechanism will cause it to become inflamed and painful when in motion. A strenuous game of tennis without previous toughening or exercise may cause a traumatic synovitis of the tendon sheaths in the neighborhood of the wrist. The synovia are red and there may be some external swelling. The area will be locally tender and pain will be elicited by all motions of the hand which involve sliding back and forth of the tendons in the sheaths, particularly when under tension. Palpation of the affected area during the performance of motion may appreciate a sensation of fine crepitus caused by the rubbing together of the inflamed surfaces of the tendon in the inflamed sheath. Overuse of the wrist- or elbow-joint may bring about a similar condition, with increased effusion of joint fluid, causing pain. Overuse of the shoulder-joint may cause a traumatic tenosynovitis of the tendon of the long head of the biceps. The treatment of tenosynovitis is the immobilization of

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[1] Kirchenberger, A.: Med. Klinik, May 21, 1926.

[2] McWilliams, Clarence A.: Lewis, Practice of Surgery, vol. ii.

the affected part until the pain subsides. Where the tendon sheaths in the neighborhood of the wrist are involved a padded wood splint will be bandaged to the upper surface of the forearm and hand. In the case of the shoulder the immobilization of the arm in a sling may suffice. A Velpeau bandage may be necessary, however. The patient should not resume exercise of the affected part until all tenderness on pressure and pain induced by motion have completely subsided. The exercise will then be cautiously resumed. Recovery is hastened by the application of heat, in the form of diathermy, radiant heat, hot fomentations, electric pad, etc. The use of mild counterirritants, as one painting of iodine, various liniments, and gentle inunction of "iodex with methyl salicylate," are often of value.

Chronic synovitis has been caused by exanthematous disease, tuberculosis, syphilis, rheumatism, etc. The local treatment outlined above is supplemented by measures directed at the underlying systemic condition.

Where the shoulder-joint must be immobilized for a long time the arm should be placed in abduction on an aëroplane splint, or in a cast.

14. **Bursitis.**—Bursæ are small sacs lined with synovial membrane. They are situated in the neighborhood of joints where tendons press upon bones or the joint capsule, or they may be found between the skin and superficially situated bones. Certain bursæ are constant and others are only present when there is prolonged irritation. There are perhaps a thousand bursæ present in the human body, and they act between the moving parts as a sort of lubricating buffer. The synovial membrane of the bursal sac may become inflamed from overuse or, possibly, from a low-grade infection secondary to a distal focus of infection, as an abscessed tooth, infected tonsil, or the like. Inflammation of the bursa will cause pain when any motion is made which causes the surfaces to rub together. This pain may be so severe as to completely incapacitate the motion of the affected part. There will often be marked tenderness to pressure of the affected bursa. In advanced cases, particularly in the subdeltoid bursitis, a deposition of calcium salts will take place and a calcified bursa will result. According to Carnett[1] careful observation has shown that the calcareous deposits are usually extrabursal. By the term "exostosis bursata" is meant a benign tumor that arises from the epiphyseal portion of the bone. It consists of bone and cartilaginous tissue covered by a connective-tissue capsule.[2] In cases of chronic bursitis with excessive fluid

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[1] Carnett, J. B.: Surg., Gynec., and Obst., 1925, 41, 404.

[2] Abramowa, A.: Zentralbl. für Chir., 1925, 52, 2649.

caused by low-grade pyogenic infection, trauma, or tuberculosis, small foreign bodies, termed "rice bodies," may be found in the bursæ. Their origin has been carefully studied by Mumford.[1]

Acute bursitis is extremely disabling, and unless prompt and proper treatment be instituted, the ailment may be prolonged into a chronic bursitis. The principal measure in the treatment of acute bursitis is the immobilization of the bursa and the application of external heat and counterirritants. Diathermy has been extremely valuable in these cases. Cold applications have been recommended. The immobilization should be continued until the pain and tenderness have practically disappeared, when very restricted actual motion and massage is actually started.

(*a*) *Acromial Bursitis.*—Inflammation of the acromial bursæ are acute or chronic, and are generally caused by trauma. The chronic type is caused by repeated traumatisms following upon carrying hard objects upon the shoulders, as in hod-carriers. There is a circumscribed, fluctuating swelling over the acromion which usually is painless (McWilliams). The condition will generally quickly yield to the removal of the traumatism and the application of heat or cold, and the institution of rest. Repeated aspirations are of use, and the infected cases must be thoroughly drained.

(*b*) *Subdeltoid Bursitis* (*Subacromial Bursitis*).—Inflammation of the subdeltoid and subacromial bursæ is so commonly found concomitantly that they will be considered together. The subacromial bursa facilitates the movement of the head of the humerus beneath the deltoid muscle. Three types of subacromial bursitis are described: the traumatic, those due to focal infection, and the suppurative. This ailment may follow excessive overuse of the shoulder-joint. It may come about following a short period of overuse or as a consequence of long-continued exercise, as in persons who have to hold the arm abducted for long periods, as dentists and artists. There is severe pain in the region of the shoulder. There may be a tender swelling just below and in front of the tip of the acromion process. Pressure upon the greater tuberosities of the humerus may occasion pain. Any movement causes muscle spasm and severe pain. There is limitation of movement. The treatment of acute subdeltoid bursitis is to bandage the arm to the chest wall by means of a Velpeau bandage, with a soft axillary cotton pack, and to apply heat externally to the shoulder. Aspirin, atophan, or, if necessary, codein will be exhibited. The arm will be maintained in immobilization until the pain and tenderness have greatly improved.

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[1] Mumford, E. B.: Jour. of Bone and Joint Surgery, 1927, 9, 381.

This may be from three to fourteen days. The bandage is then removed and a sling is substituted. Diathermy and skilful, gentle massage at this juncture will be very valuable. As the pain and tenderness continue to subside increased active motion is permitted. In cases which do not yield to treatment in this short time it will be wise to immobilize the shoulder with the arm in ninety degree abduction by means of an aëroplane splint. This will relax the tension of the deltoid muscle and remove some of the pressure upon the bursæ. In some cases the recumbent treatment with traction upon the humerus will be advisable. In the milder chronic cases skilful stretching, as described by Gordon,[1] will be valuable. Cooperman[2] says that experience has shown that conservative measures should supersede surgical procedures. Spontaneous recovery occurs even in the calcific variety of the affection. The condition is benefited most by rest of the shoulder in the abducted position, combined with diathermy. Carnett[3] analyses 44 cases out of which 19 were operated upon. In all of this author's acute cases the pain was relieved at once by the operation. In the chronic cases it ceased after from one to several weeks. The operation used by Carnett is as follows:

The incision is made from the acromial process downward 2 or 3 inches toward the deltoid insertion and across the greater tuberosity. The deltoid fibers are split to expose the roof of the acromial bursa. The bursal sac is then carefully opened and explored with a curved hemostat or the finger, aided by manipulation of the arm. In some cases the breaking up of adhesions was necessary. The deposit can be seen upon the floor of the bursa as a grayish substance. The bursal floor is incised, and the deposit removed with a curet. In the more recent cases the bursal sac has not been sutured, but has been drained for twenty-four hours with a rubber tube.

After the operation, motion is encouraged from the first day, and on the fourth day the patient begins active abduction by creeping up a wall with the hand. Harris'[4] report is striking testimony of the value of diathermy in the treatment of subdeltoid bursitis, even where calcification is present. Harris' patient had had intermittent attacks for seven years. After two weeks' treatment he resumed the playing of a bass viol and after thirty-two treatments all pain and restricted motion has disappeared. Of great interest is the actual absorption of the calcified deposit as shown by the x-ray (see Figs. 203, 204). Grossman[1] advises that when adhesions have formed in the bursa the arm should be manipulated under anesthesia and held fully extended for a day or two with external heat. In the severe cases of chronic bursitis with

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[1] Gordon, Donald: Lewis, Practice of Surgery, vol. ii, chap. 5, p. 63.

[2] Cooperman, M. B.: New York State Jour. Med., 1926, 26, 807.

[3] Carnett, J. B.: Surg., Gynec., and Obst., 1925, 41, 404.

[4] Harris, J. F.: Jour. Amer. Med. Assoc., 86, 1134, October 10, 1925.

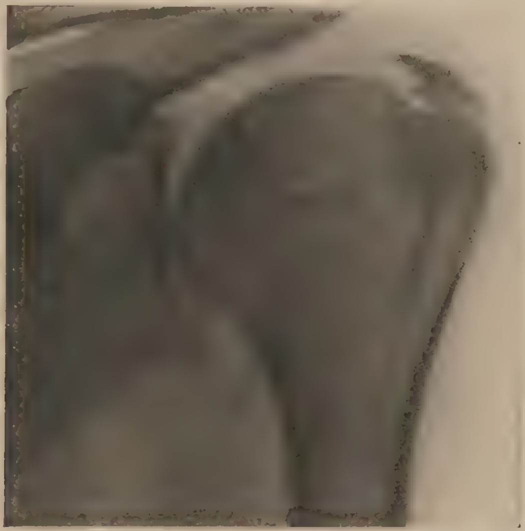

Fig. 203.—Calcified subdeltoid bursitis. (Harris, J. F., Jour. Amer. Med. Assoc., October 10, 1925.)

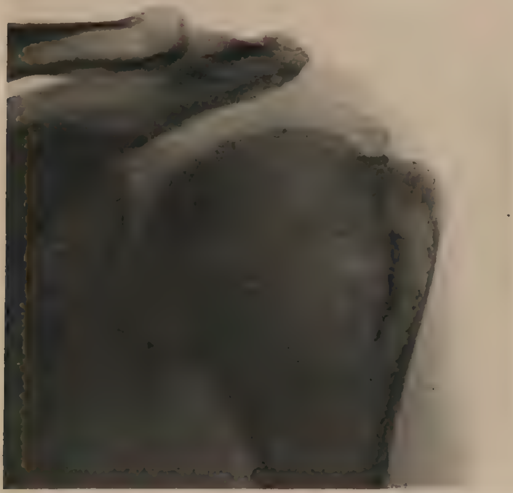

Fig. 204.—Calcified subdeltoid bursitis shown in Fig. 203 after a course of treatment by diathermy. (Harris, J. F., Jour. Amer. Med. Assoc., October 10, 1925.)

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[1] Grossman, J.: Medical Times, 53, 131, 1925.

calcification of the bursæ, open operation with incision of the bursa will be indicated. This is not a minor surgical operation. The causes of shoulder pain include a wide variety of conditions, and they should be included in a consideration of the differential diagnosis of subdeltoid and acromial bursitis. These causes are discussed by Butler and Elward[1] chiefly from the standpoint of the lesions demonstrable by the *x*-ray. In abstract, their paper is as follows:

According to French's Index to Differential Diagnosis, the direct causes of shoulder pain include injury, arthritis, synovitis, fibrositis, myositis, neuritis, bursitis, and local paralysis. Indirect causes of shoulder pain are angina pectoris, aneurysm, pleural, pulmonary, and mediastinal conditions, gastric lesions, duodenal lesions, cervical rib, hepatic lesions, nerve lesions, tumor of the neck, spinal tumor, gliosis, and neuroma.

Other causes that have been suggested are pulmonary infarct, actinomycosis of lung, the subphrenic abscess, perisplenitis, acute pancreatitis, suprarenal tumor, tumor of the hypophysis, apical tuberculosis, hypertrophic arthritis of the cervical vertebræ usually occurring in the lower four bodies and causing irritation of the brachial plexus. Calcified cervical glands (healed tuberculous glands) may also cause such irritation. They need not be large to affect the nerves.

Clavicular spurs are usually near the outer end and underneath. They may result from periosteal injury or may be congenital. They also cause nerve irritation.

Calcified deltoid bursa should be called "opaque" deltoid bursa because calcium is not always present. The opacity may disappear on the application of heat or electrotherapy.

The explanation given for shoulder pain arising from lesions in the neighborhood of the diaphragm is that the phrenic nerve has its origin near that of the brachial plexus which supplies the shoulder.

Many of the conditions enumerated may be demonstrated by the Roentgen ray. A 10 by 12 inch film will cover the shoulder, cervical region, clavicle, upper thorax, and mediastinum. The demonstrable lesions are cervical caries, cervical rib, cervical arthritis, calcified glands, clavicular spur, opaque bursa, aortic aneurysm, apical tuberculosis, apical neoplasm, mediastinal new growth, Hodgkin's disease, and injuries or lesions in the shoulder itself.

(*c*) *Olecranon Bursa.*—Inflammation of the olecranon bursa commonly occurs from the traumatism of resting the olecranon process on a hard surface. Lasher and Mathewson,[1] who made a study of 15 cases, describe three distinct bursæ in the region of the olecranon as follows:

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[1] Butler, P. F., and Elward, J. F.: Amer. Jour. Roentgenol., 1925, 13, 536, abstracted in International Abstract of Surgery, by W. A. Clark.

1. "A large subcutaneous bursa lying directly beneath the skin, which when fully distended, measures about $2\frac{1}{2}$ inches in length, $\frac{3}{4}$ inch in width, and is of varying thickness, with the upper half lying above the tip of the bone and the remaining portion firmly attached to the underlying periosteum.

2. "A small bursa which is not easily demonstrable within the tendinous attachment of the triceps.

3. "A slightly larger bursa underneath the tendinous insertion of this muscle."

The bursa over the olecranon process will become swollen, red, and tender. Minute superficial abrasions or the wounds incurred by aspiration may provide the portal of infection for the bursa. Rest and the avoidance of pressure on the olecranon process, and the application of heat will generally remedy the milder cases of this ailment. The application of a pressure pad has been recommended by some, but its usefulness is questionable. According to Lasher and Mathewson[2] acute infection of the olecranon bursa demands an early operation with complete removal and if an operation be not performed, an osteomyelitis of the underlying bone is a most frequent complication. Lasher and Mathewson advise a 2-inch longitudinal incision which is slightly elliptical so as not to leave a scar directly over the olecranon. The curve of the ellipse should be toward the radial side. Because of the difficulty in separating the attached portion of the bursa without opening the periosteum, these authors advise that this small area be curetted and phenolized in order to destroy any secreting cells and to remove completely the infected tissues. The wound is closed without drainage. After operation a snug bandage is applied with pressure over the bursal site to prevent reaccumulation of fluid. Motion is instituted at once. McWilliams advises early aspiration and compressive bandage. He advises operation in the chronic or infected cases. In the latter, after "scrapping the wall" of the bursa, drainage is employed. In the more chronic cases excision of the bursa will be required. The bursa is superficial and the excision may readily be carried out under local anesthesia.

(*d*) *Radiohumeral Bursitis, Epicondylitis, "Golf Elbow."*—The excessive supination and pronation incident to a strenuous game of golf and certain other activities may bring about an inflammation of the bursa at the radiohumeral articulation. A tender point may be felt over the head of the radius or external condyle of the humerus and supination and pronation will elicit pain in this area. There may be weakness on attempting to lift relative light objects. According to McWilliams, the essential pathology is believed to be "an inflammatory reaction in a commonly existing bursa, varying in size, and located beneath the conjoined tendon of the extensor muscles between this tendon and the tip of the epicondyle, the origin of the supinator radii brevis muscle, and the radiohumeral joint." Immobilization in a sling and external heat will cure the milder cases. The more severe cases will require complete immobilization of the arm and forearm in a plaster cast for six weeks. A window may profitably be cut in the cast over the bursa in order to paint the overlying skin with tincture of iodine and other counterirritants. Intractable cases may require the curetting of the bursa.

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[1] Lasher, W. W., and Mathewson, L. M.: Jour. Amer. Med. Assoc., 90, 1030, March 31, 1928.

[2] Ibid.

Dislocation of the Long Head of the Biceps.—Although Binnie says that it is difficult to imagine this injury without dislocation of fracture to the head of the humerus, the recent studies of Meyer[1] not only show its relatively common occurrence, but also its threat of tendon destruction. This author says: "Uncomplicated, partial, or complete, spontaneous forward dislocation of the supratuberosital and interbuberosital portions of the tendon of the long head of the biceps, onto or over the lesser tuberosity as far as the tendon of the subscapularis, is common in laborers past middle life. This dislocation may be due to gradual stretching, detachment or destruction of the capsule proximal to and in the region of the lesser tuberosity." The tendon may become divided by attrition and obtain a secondary attachment to the humeral diaphysis or it may retract completely before becoming attached. Fievez and Lecene[2] report a case of spontaneous intracapsular rupture of the tendon of the long head of the biceps brachialis. These authors thought that the tendon was gradually "filed" through by the process of dry arthritis, and finally ruptured spontaneously.

15. **Dislocations Involving the Upper Extremity.**—(*a*) *Dislocation of the Shoulder* (*Humerus*).—Because of the relative insufficiency of bone support and because of its exposed position the shoulder joint is very frequently subject to dislocation, 40 to 65 per cent. of all dislocations in the body. It occurs most frequently in muscular young adults as a result of falling on the hand or elbow with the arm ab-

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[1] Meyer, A. W.: Arch. of Surg., 17, 493, March, 1928.

[2] Fievez and Lecene: Bull. et mem. Soc. nat. de chir., 1926, 52, 1210.

ducted or externally rotated, as in trying to protect one's self in a backward fall. "The weight of the body is transmitted to the head of the humerus, driving it downward and forward against the lax weak portion of the capsule of the joint."[1] The anterior inferior portion of the joint capsule is the weakest point. Dislocation of the shoulder always involves a rent in the capsule. Anterior dislocation is much more common than posterior dislocation because of the stronger posterior muscles. The four commoner types of dislocation of the shoulder are: (*a*) Subcoracoid (beneath the coracoid process); (*b*) subglenoid (beneath the glenoid process); (*c*) subspinous (beneath the spine of the scapula), and (*d*) subclavicular (beneath the clavicle). Other rare types of dislocation have been described.

The diagnosis of the various varieties of dislocation of the shoulder is aided by a consideration of the following table from T. Pickering Pick's "Fractures and Dislocations" (quoted by DaCosta, J. C., Modern Surgery, 9th ed., W. B. Saunders Co., 1926, p. 626):

Type.	Direction of the axis of the limb.	Alteration in the length of the limb.	Presence of the head of the bone in new situation.
Subcoracoid.	The elbow is carried backward and slightly away from the side.	Very slight lengthening.	The head of the bone cannot easily be felt; it is found at the upper and inner part of the axilla.
Subglenoid.	The elbow is carried away from the trunk and slightly backward.	Very considerable lengthening.	The head of the bone can easily be felt in the axilla.
Subspinous.	The elbow is raised from the side and carried forward.	Lengthening intermediate in degree between the subglenoid and the subcoracoid.	The head of the bone can be felt and be grasped beneath the spine of the scapula.
Subclavicular.	The elbow is carried outward and backward.	Shortening.	The head of the bone can readily be seen and be felt beneath the clavicle.

Dislocation of the shoulder is commonly accompanied by fracture of the greater tuberosity of the humerus, fracture of the surgical neck of the humerus, or fracture of the body of the scapula. The diagnosis is readily made by inspection and palpation, and the history of a fall or muscular violence. It is important to remember that a fracture of the surgical neck of the humerus may resemble a dislocation and one should be cautioned against ill-advised and dangerous attempts to reduce what is thought to be a dislocation of the humerus when, in reality, it is a fracture.

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[1] Eliason, E. L.: Nelson Loose-leaf Living Surgery, Thos. Nelson & Sons, vol. iii, p. 204.

Forward dislocations of the shoulder-joint generally may be reduced by the Kocher maneuver (Figs. 205–208). The successful accomplishment of this maneuver is in a large part dependent upon the tact and the skill of the surgeon. Often the patient will previously have had painful and clumsy unsuccessful efforts to reduce the shoulder. He should be told at the outset that the effort to reduce the shoulder by the Kocher maneuver may occupy ten or fifteen minutes of time and extreme patience and effort will be necessary on his part to bring about as much relaxation of the muscles of the shoulder as possible.

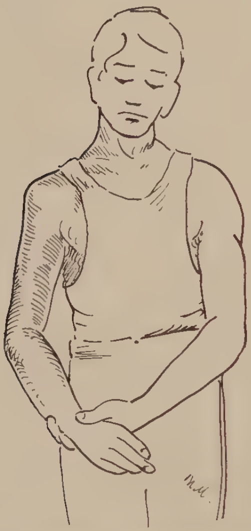

Fig. 205.—Sketch showing position of arm in dislocation of the shoulder.

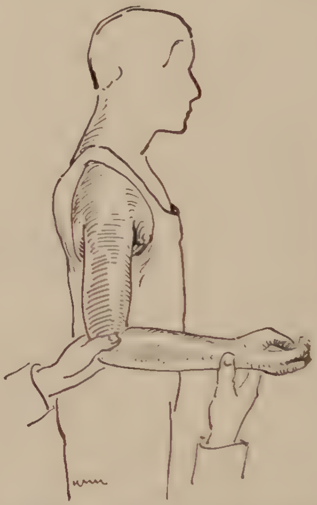

Fig. 206.—Kocher maneuver for dislocation of the shoulder. First step: The elbow is very slowly and gently brought close to the side and very slightly posterior to the midaxillary line.

He will be treated best seated on a bench or stool. The surgeon will be seated at the affected side. Eliason and also Ashhurst recommend that the patient be treated lying on his back. The maneuver may best be described by breaking it up into the following components: (*a*) The forearm is grasped at the wrist and elbow, with extreme gentleness so as not to produce any inadvertant motions of the arm. The forearm is flexed to a right angle upon the arm and with great patience the elbow is slowly brought inward until it touches the thorax. The elbow should be so guided in this maneuver that it comes to rest an inch, or 1½ inches, posterior to the midaxillary line (Fig. 206). Some three or four minutes may have been consumed in carrying out this first step. (*b*) The forearm, which up to this time has been directed anteriorly, is now slowly and gently swung around to the side so that it points as far laterally as possible (Fig. 207). This step causes an external rotation of the head of the humerus. (*c*) The elbow and forearm are now brought forward and upward anteriorly so that the arm gradually assumes the position at right angles to the body and directed anteriorly (Fig. 208). By this time the luxation may have been reduced. (*d*) The forearm in the fourth step is now swung rapidly inward and across the front of the body (Fig. 208). It must be emphasized again that the degree of success in the Kocher movement will be directly dependent upon the patience and gentleness of the operator. Should the maneuver fail, a second and third trial will be made. Should these fail, the Astley Cooper, or traction method, should be tried. The patient should be placed upon the floor in the dorsal position, and the surgeon, who is seated upon the floor, will place his stockinged-foot in the axilla of the patient. The wrist of the patient

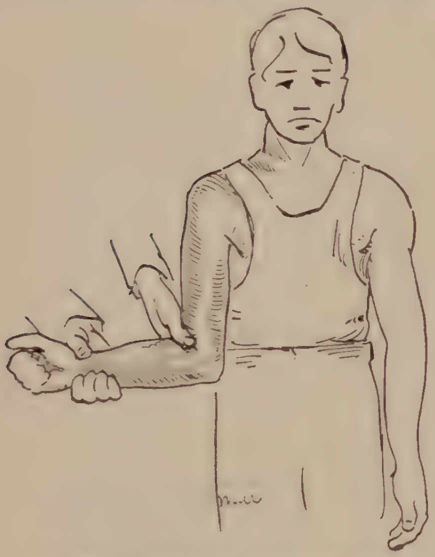

Fig. 207.—Kocher maneuver for dislocation of the shoulder. Second step: The elbow is held fixed and the forearm is slowly and gently rotated outward.

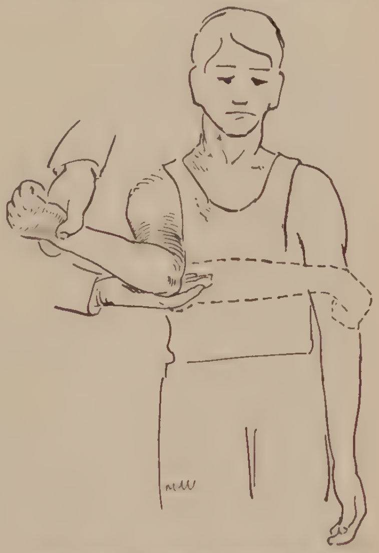

Fig. 208.—Kocher maneuver for dislocation of the shoulder. Third step: Keeping the forearm externally rotated, the elbow is lifted slowly upward. Fourth step: The forearm is quickly rotated inwardly.

will be firmly grasped and a steady strong traction will be made upon the wrist. In 1 case the writer was compelled to exert this traction in the case of a nervous woman for some ten minutes before reduction was effected. Cases which do not yield to the above measures will require general anesthesia for reduction. In all cases of dislocation of the shoulder it will be well to make an x-ray examination following reduction to see if there has been any minor fracture of the humerus or scapula. Of course, in all cases where there is any suspicion of a fracture of the surgical neck of the humerus, or where the diagnosis of dislocation of the humerus is not perfectly evident, an x-ray examination should be made *before* any treatment is attempted. The arm will be suspended in a sling for ten days to two weeks, after which gentle active motion and massage are started. Eliason[1] fastens the arm to the chest by a Velpeau bandage or sling and circular band for a week, taking care to first place powdered gauze in the axilla. At the end of a week the dressing is temporarily removed for slight motion and care of the skin. Abduction should be avoided for at least four weeks. If sufficient care be taken the rent in the capsule will heal and there will be an excellent result.

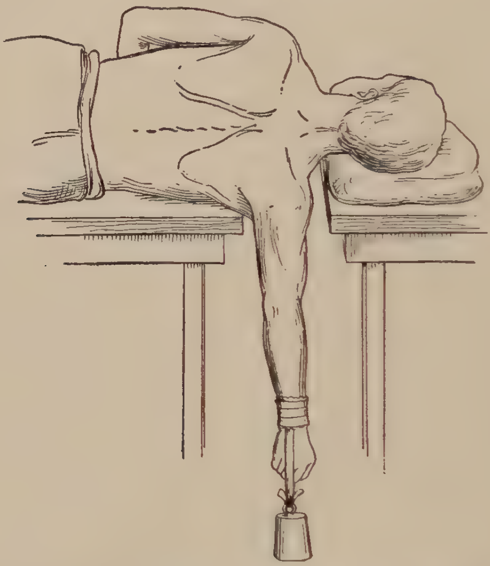

Fig. 209.—Stimson's method of reducing a shoulder dislocation. (From Moorhead. Traumatic Surgery.)

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[1] Eliason, E. L.: Nelson Loose-leaf Surgery, Thos. Nelson & Sons, 1927, vol. iii, p. 210.

In many cases the dislocation of the shoulder will occur repeatedly, a condition which is spoken of as recurrent or habitual dislocation. Some of these cases will be benefited by a prolonged period (six to eight weeks) of complete immobilization in a Velpeau bandage, but the majority of them will require a plastic operation upon the capsule of the shoulder-joint. This procedure belongs to the province of major surgery.

(b) *Dislocation of the Elbow.*—Falls upon the extended end or twists of the forearm may bring about dislocations of the elbow. Dislocations of the elbow may be backward, forward, or lateral (Figs. 210–212). One or both bones of the forearm may be involved. By far the commonest is the backward dislocation. The existence of this injury may readily be recognized by the inability to flex the arm, by the marked prominence of the olecranon process, and by the unnatural depression of the arm immediately above the olecranon process. Rarely it will be possible to reduce this dislocation without anesthesia. Much more commonly general anesthesia will have to be employed. Backward pressure is made upon the lower end of the humerus and by alternately flexing and extending the forearm and, at the same time, placing traction upon it, the olecranon fossa may generally without much difficulty be hooked over the lower end of the humerus. The arm may be grasped from behind with the thumbs on the tip of the olecranon, and the fore-

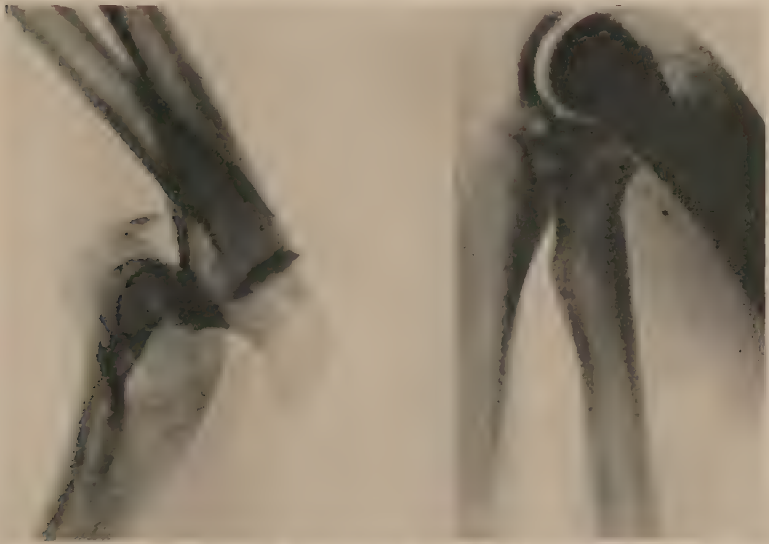

Fig. 210.—Posterior dislocation of elbow with fracture of coronoid process. Condition after reduction of dislocation.

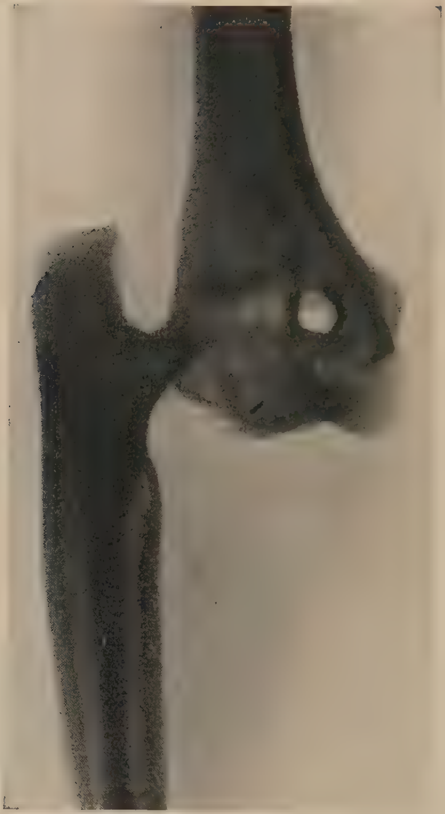

Fig. 211.—Dislocation of the elbow. Anteroposterior view.

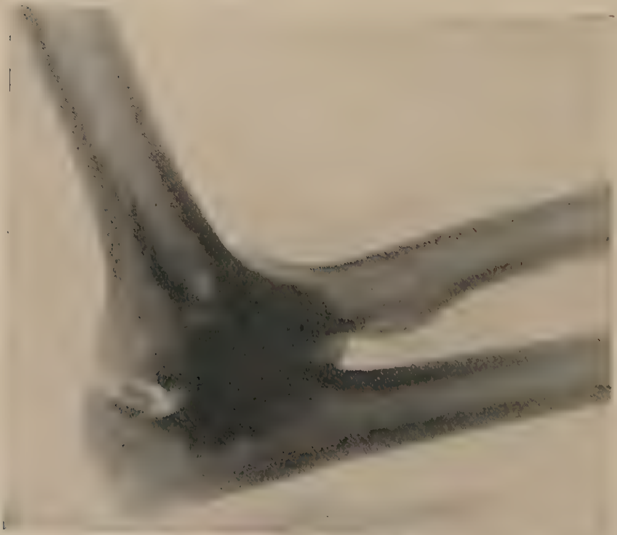

Fig. 212.—Dislocation of the elbow shown in Fig. 211. Semilateral view.

arm gradually forced forward, or by bending it across the knee so as to produce traction of the forearm with countertraction on the arm.

In all cases of suspected dislocation of the elbow an *x*-ray examination must be made before any manipulations are carried out because of the frequent occurrence of transverse fractures of the lower end of the humerus with backward displacement of the lower fragment. Where the swelling has become marked, and even in the absence of swelling, this injury may closely simulate a posterior dislocation of the elbow. The reduction of a fracture of this type would require different manipulations than reduction of the dislocation. Where the *x*-ray confirms the diagnosis of dislocation of the elbow, it is quite common to discover a coincident fracture of the tip of the coronoid process of the ulna. This fragment generally resumes its approximate previous position after the manipulation and rarely gives rise to trouble. After the dislocation has been reduced the arm will be put up in a moderate degree of flexion and held there either by sling or by a transverse adhesive band from the wrist to the upper arm. This band must have beneath it adequate padding to prevent cutting into the skin of its edges. Gentle active motion should be instituted on the fourth or fifth day, and massage or heat treatment will be carried out from that time on. Eliason advises the acutely flexed position for a week, and does not remove all restraint until the end of four weeks. It would seem, however, that an earlier removal of restraint will accelerate the recovery. By the fifteenth or twentieth day all but 45 degrees of extension should be obtained. In adults, however, complete extension rarely occurs before the third or fifth month, and the patient should be apprised of the likelihood of this considerable period of time before recovery takes place.

(*c*) *Dislocations of the wrist* are extremely uncommon, and the deformity in the posterior type will resemble a Colles fracture. Forward dislocation of the wrist is rare. Various other varieties are described. The treatment will be reduced by manipulation and extension, generally under anesthesia, and the immobilization in a molded plaster splint for ten days to two weeks. After this time active and passive motion and physiotherapy will be instituted.

(*d*) *Dislocation at the Inferior Radio-ulnar Articulation.*—This injury may be caused by extreme torsion of the wrist. Reduction in this rare injury is accomplished by extension and immobilization and it is immobilized for a relatively long period—four weeks. Passive motion may be begun at the end of twenty days.

(*e*) *Dislocation of the Carpal Bones.*—The diagnosis of this rare injury generally is made only by x-ray. It is treated by manipulation under anesthesia and immobilization in a molded plaster splint or a circular cast (Fig. 213). x-Ray examination should confirm the reduc-

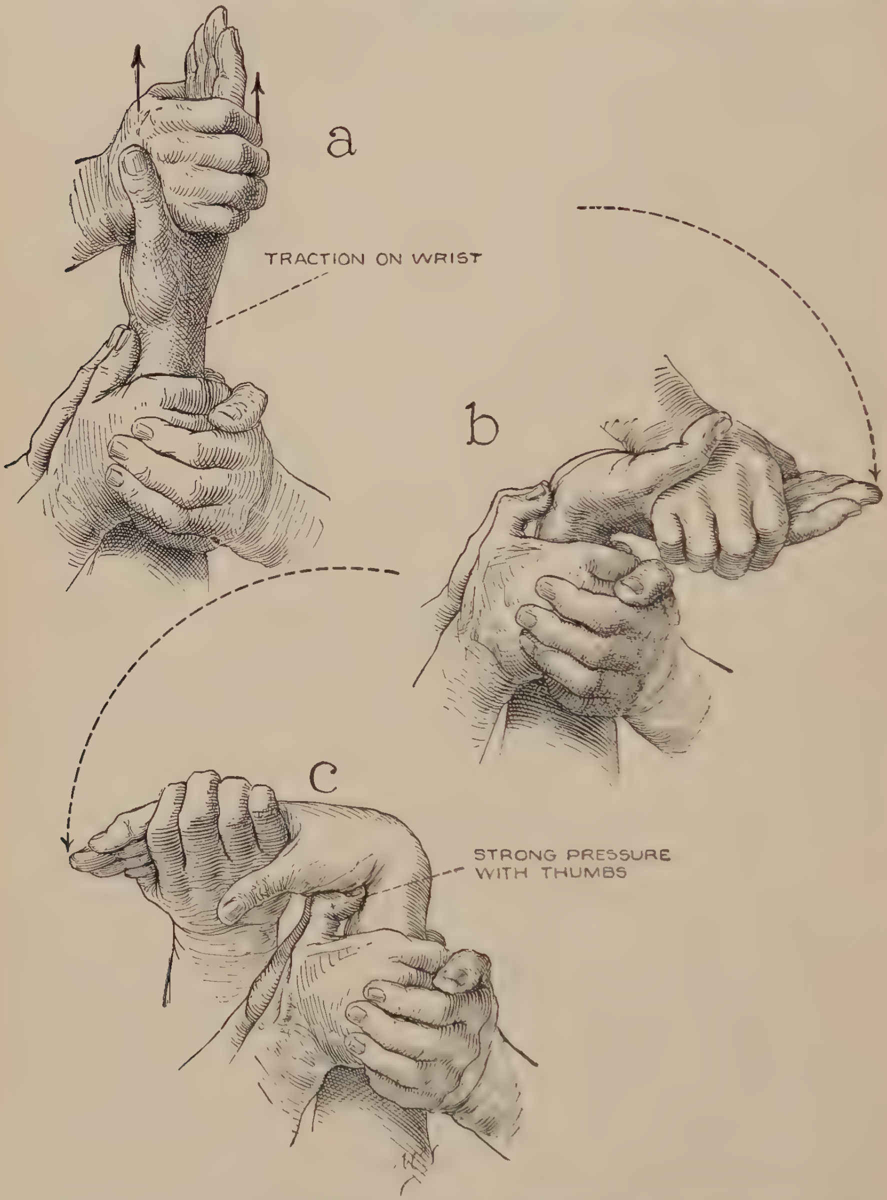

Fig. 213.—Method of reduction of dislocated semilunar bone: *a*, Strong traction by operator, assistant's thumbs over semilunar; *b*, full dorsiflexion continuing traction; *c*, full palmar flexion over assistant's thumb as fulcrum. (From Forrester's "Imperative Traumatic Surgery," published by Paul B. Hoeber, Inc.)

tion. Reduction of a dislocation of the semilunar should be attempted up to three weeks after the injury unless the bone is torn free from its attachment and lies free under the skin. In the latter event it should be excised under local anesthesia.

McBride[1] says that dislocation of the semilunar bone is the third most common injury of the wrist, and that unless the condition is diagnosed and properly treated early the prognosis is unfavorable. He concludes:

1. Reduction by manipulation within three days can usually be accomplished, with a good functional result.

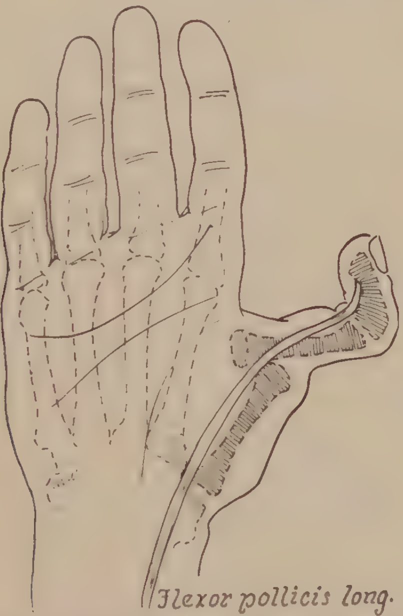

Fig. 214.—Diagrammatic representation of dislocation of the thumb. The proximal phalanx may be engaged behind the flexor pollicis longus tendon.

2. Excision after two or three weeks results in good function, but some permanent weakness.
3. Open reduction promises as good a return of function as removal.
4. In untreated cases there is disability of from 25 to 75 per cent.
5. In old cases open reduction should not be attempted; excision is better.
6. In the presence of marked fixation and degenerative changes removal will relieve pain, but will improve function only slightly.

(*f*) *Dislocation of the Metacarpophalangeal Joint of the Thumb.*—Dislocation of this joint is not uncommon and is usually of a backward variety (Fig. 214). The reduction of the backward variety is difficult

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[1] McBride, E. D.: Arch. of Surg., 14, 584, 1927.

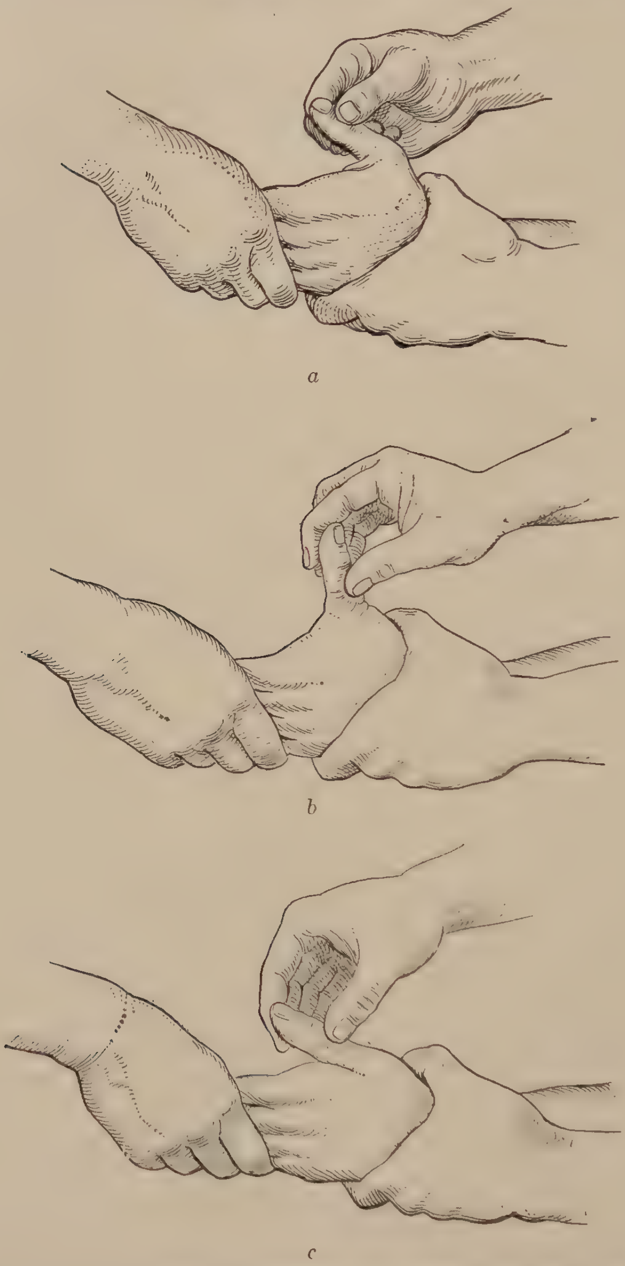

Fig. 215.—Steps in reduction of metacarpophalangeal dislocation of thumb: *a*, Abduction or hyperextension; *b*, dorsal flexion and downward pressure; *c*, traction and adduction. (From Moorhead, "Traumatic Surgery.")

and DaCosta advises always administering ether. The directions of Keetley (quoted by DaCosta) are to abduct the metacarpal bone into the palm, which relaxes the flexor muscles, and to have it held there by an assistant; then bend the thumb strongly back, extend, pull the thumb toward the fingers, and suddenly flex (Figs. 215, 216). If these maneuvers fail, open operation will be required. The immobilization should be for three weeks. Forward dislocation is readily reduced by strong extension and flexion.

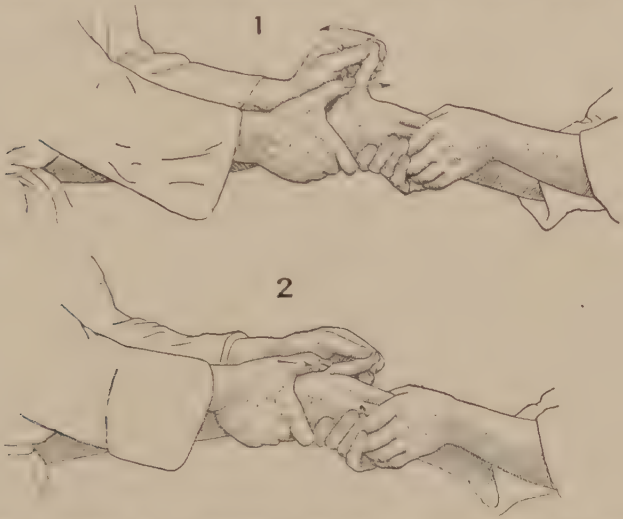

Fig. 216.—Reduction of dislocation of the thumb. 1, Extension of thumb with downward pressure at the base. 2, Continued pressure at base of thumb with flexion and traction. (Maissonet, "Petite Chirurgie.")

(g) Dislocation of the Phalanges.—These dislocations are easy of diagnosis and readily reduced by extension and manipulation. They should be fastened in flexion over a roller bandage, or splinted for one week at least.

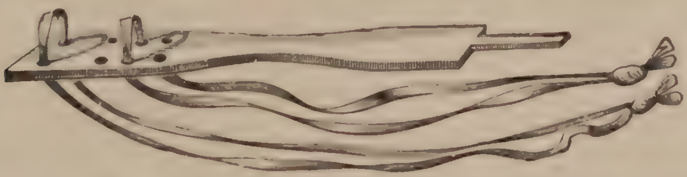

Fig. 217.—Levis' splint for reducing dislocation of the thumb and phalanges.

16. **Minor Fractures of the Upper Extremity.**—Some of the older rules which were laid down as guides to the diagnosis of fractures are now obsolete. The elicitation of crepitus generally is barbaric and

unnecessary. The history, appearance, general configuration of the limb, and site of tenderness as appreciated by gentle palpation generally will suffice to make a diagnosis. Any patient who has suffered from a fall or a blow and experiences pain in any part of the upper extremity and who has reluctance to move the extremity, must be considered as a potential fracture case. Inspection of the extremity will very commonly show a deformity pathognomonic of fracture and further diagnostic procedure will be unnecessary. In the absence of deformity the surgeon will palpate with extreme gentleness the affected extremity, beginning with that portion which probably is *insensitive* to pain and gradually approach the probable tender area. If there be tenderness to slight pressure over any part of the bone, a fracture should be suspected. The first concern of the surgeon will be in regard to the best measure to most comfortably transport the patient to a place where an *x*-ray examination may be made. In the majority of cases of any fracture of the upper extremity it will be most expedient simply to permit the patient to rest his forearm upon a pillow, or support it in a sling. Often the patient will prefer to support the injured extremity by grasping his own forearm and carrying it. In cases where there is marked abnormal mobility of the forearm or in the wrist so that the slightest motion is painful, a temporary splint will be applied. This will be made of wood, cardboard, or whatever suitable material is at hand. It will be padded with cotton and gently bandaged to the forearm, using care to apply the bandages loosely over the fracture site and firmly above and below. Many cases of complete fracture of the humerus are best transported without any fixation. In others the humerus will be bandaged firmly to the side by a Velpeau bandage. Once the patient has been brought to the *x*-ray laboratory, *x*-rays will be made in two views. Reduction will be accomplished and immobilization carried out. A standard rule in the treatment of all fractures of the extremity is the avoidance of too tight a bandage. The application of a circular plaster cast in a fresh fracture immediately after reduction and before the maximum swelling has been obtained, is the classical cause of ischemic contraction.[1]

(*a*) *Epiphyseal Separations; "Bone Separations."*—Falls or blows upon the upper extremity in young children will cause an injury of the attachment of the epiphysis to the diaphysis. Union of the epiphysis with the diaphysis or shaft occurs at different ages in different bones, but, according to Stimson,[2] the union "is usually complete in all in the female at the age of twenty-two years, and in the male at twenty-five years." The order of frequency of separation of the epiphysis is about as follows[1]:

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[1] Christopher, Frederick: Illinois Med. Jour., May, 1926.

[2] Stimson, L. A.: Fractures and Dislocations, 7th ed., Lea & Febiger, p. 29.

1. The upper epiphysis of the humerus.
2. The lower epiphysis of the femur.
3. The lower epiphysis of the radius.
4. The lower epiphysis of the humerus.
5. The lower epiphysis of the tibia.
6. The upper epiphysis of the tibia.

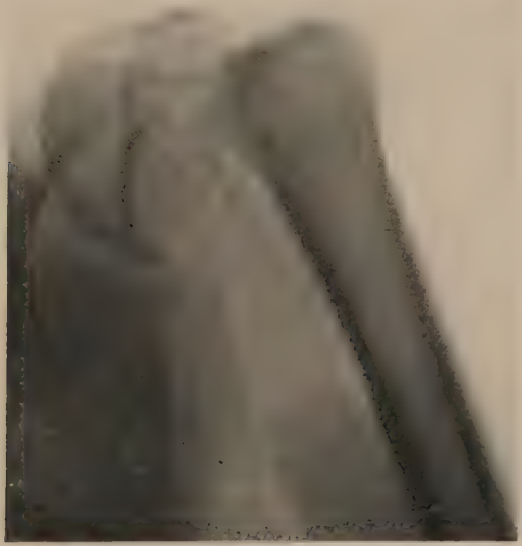

Fig. 218.—Epiphyseal separation of the head of the humerus.

Scudder says that greater force is required to cause a separation of the epiphysis than is required to cause a fracture of the same bone. This may be merely a wrench of the attachment without any pathological change visible in the *x*-ray. The diagnosis in this case will be made by the history of the injury, the situation of the tender area, and the negative *x*-ray. In many cases, however, particularly at the lower end of the humerus and radius, the epiphysis will be completely torn loose from its attachment and displaced. According to Cotton,[2] separation of the entire lower humeral epiphysis is possible up to four years of age. The location of the displaced epiphysis will be made certain by the

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[1] Poland, John: Traumatic Separation of the Epiphysis, quoted by Scudder, C. L., Treatment of Fractures, 10th ed., W. B. Saunders Co., p. 1049.

[2] Cotton, F. J.: Dislocations and Joint Fractures, W. B. Saunders Co., 1924, 2d ed., p. 310.

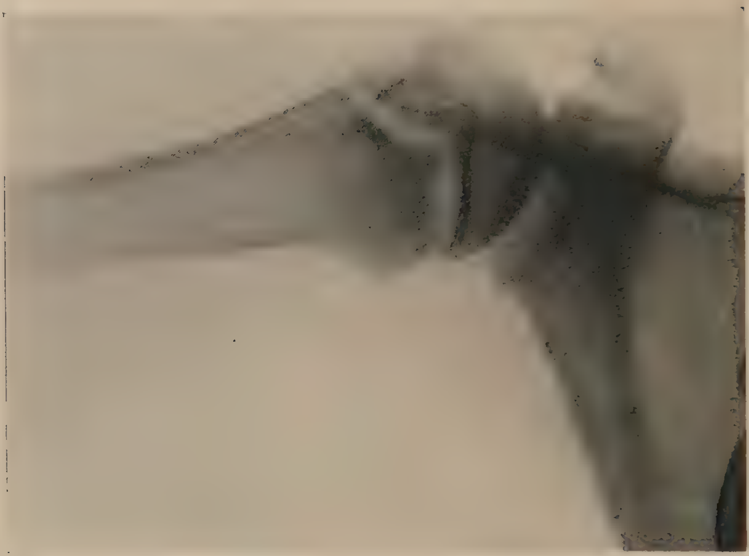

Fig. 219.—Correction of epiphyseal separation shown in Fig. 218. The deformity recurred each time the arm was brought to the side. A successful result was accomplished by having the child lie in bed with slight traction on the widely abducted arm and with the forearm suspended.

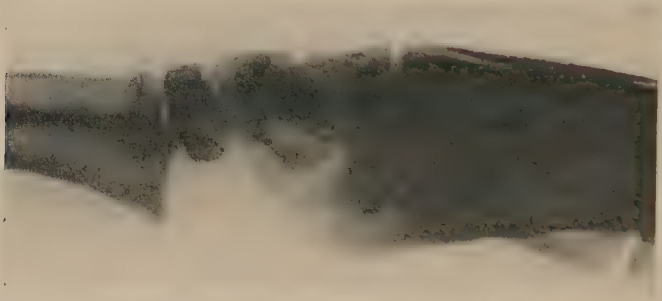

Fig. 220.—Epiphyseal separation of the radius.

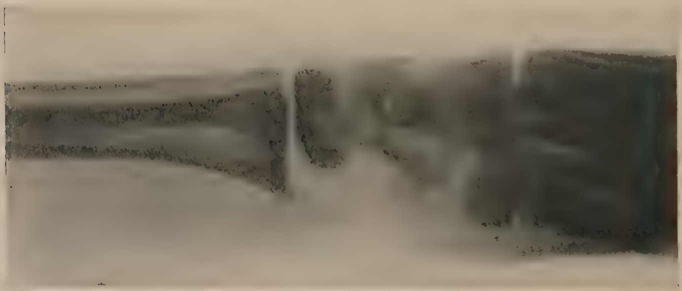

Fig. 221.—Reduction of epiphyseal separation of the radius shown in Fig. 220.

x-ray, and it will be reduced much in the manner of the displacement of fragments of bone (Figs. 218–221). In very young children, where the epiphysis is largely cartilaginous, the x-ray will give little information. General anesthesia most commonly will be required. x-Ray examination will invariably be made after reduction to insure the attainment of proper position. The period and degree of immobilization will be less than that in the case of fracture. Early mobilization will accelerate recovery. Heat and gentle massage will be of value.

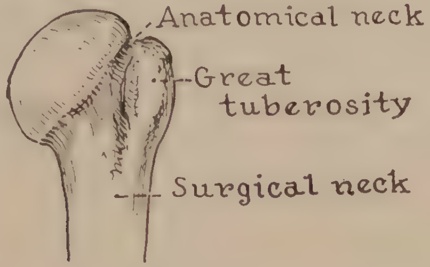

Fig. 222.—Diagram showing anatomy of the head of the humerus.

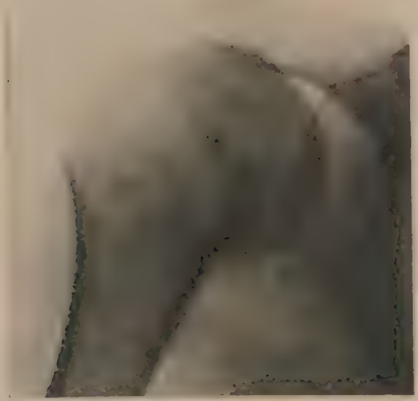

Fig. 223.—Impacted fracture of the head of the humerus. Patient did not come to a doctor for a week, after which she was treated by a sling and physiotherapy.

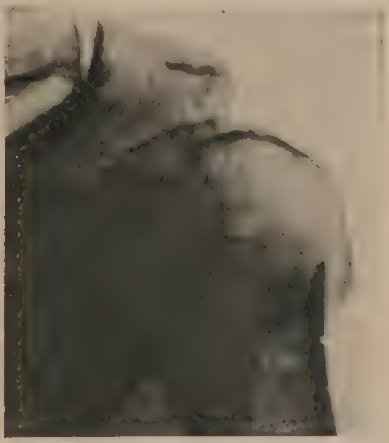

Fig. 224.—Impacted fracture of the head of the humerus.

(*b*) *Minor Fractures of the Humerus.*—1. *Impacted Fractures of the Head of the Humerus.—Impacted Fractures of Anatomical Neck* (Fig. 222).—Falls upon the outstretched hand, falls upon the elbow, and direct violence upon the shoulder itself may cause impacted fracture of the head of the humerus. Here the shaft is driven for a very slight distance into the head; but one side of the bone is generally involved (Figs. 223, 224). No immobilization is required in most cases other than the employment of a sling. In cases with marked pain the upper extremity may be temporarily (from five to seven days) immobilized by a Velpeau bandage. Early mobilization with heat and massage to the shoulder will bring about recovery in from three to five weeks.

2. *Fractures of the Greater Tuberosity of the Humerus.*—This injury may be the cause of considerable disability. It is accompanied by pain on external rotation, and tenderness at the site of the fracture. The proper treatment is the immobilization of the shoulder-joint in external rotation. Operation is occasionally necessary.

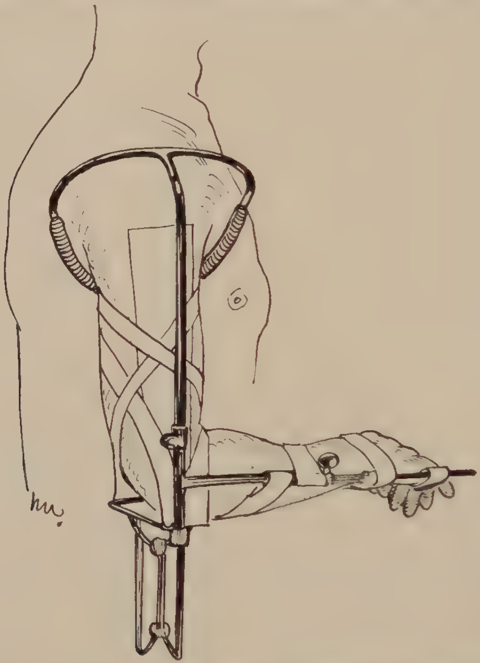

Fig. 225.—A Jones traction splint for fractures of the humerus.

3. *Incomplete Fractures of the Shaft of the Humerus.*—Where but 50 per cent. of the shaft of the bone has been involved in a fracture of the humerus the immobilization provided by a sling for three to four weeks, coupled with early mobilization of the joints, is all that will be required for cure of these cases. Where more than 50 per cent. of the shaft of the bone has been fractured, the likelihood of inadvertent fracture of the bone, converting the injury into a complete fracture, calls for firm immobilization with a Velpeau bandage and axillary pad

for from three to four weeks. Violent exercise in these cases should be refrained from for eight weeks. In some patients the Jones traction splint (Fig. 225) or the Zimmer aëroplane splints (Figs. 226, 227) will be more desirable than the Velpeau bandage.

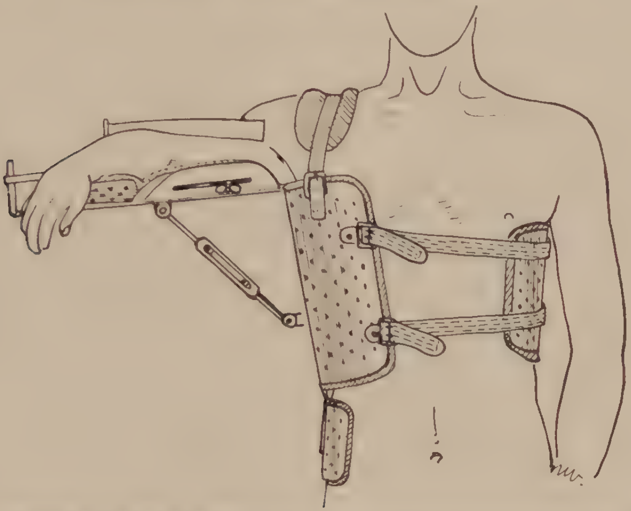

Fig. 226.—Aëroplane traction splint for fractures of the humerus (front view). (Zimmer Manufacturing Co., Warsaw, Indiana.)

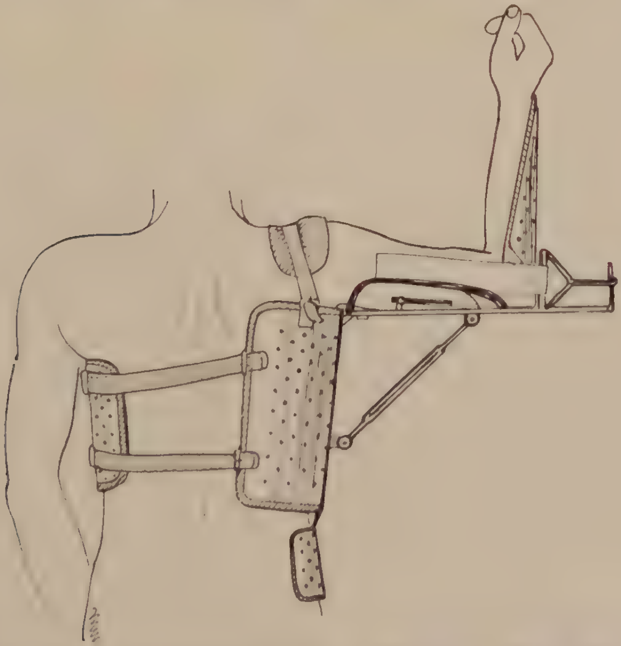

Fig. 227.—Aëroplane traction splint for fractures of the humerus (back view). (Zimmer Manufacturing Co., Warsaw, Indiana.)

4. *Fractures of the Surgical Neck of the Humerus.*—The deformity in fractures of the surgical neck of the humerus is often such as to lead the inexperienced to make a diagnosis of dislocation and to make an ill-advised attempt to reduce it. It should generally be possible to make the diagnosis by inspection and palpation, but an x-ray is indispensible. The treatment is reduction under full anesthesia. Occa-

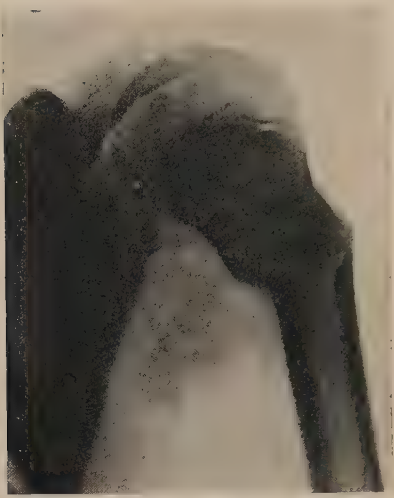

Fig. 228.—Fracture of the surgical neck of the humerus.

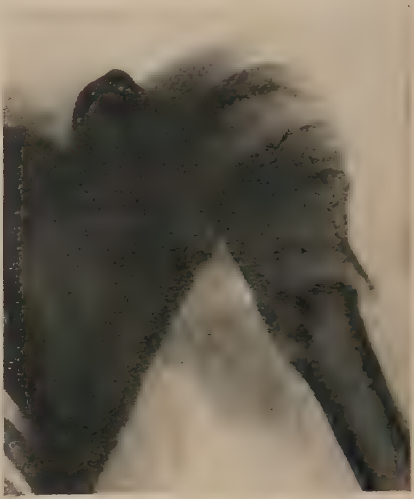

Fig. 229.—Fracture of the surgical neck of the humerus shown in Fig. 228 after reduction without anesthesia.

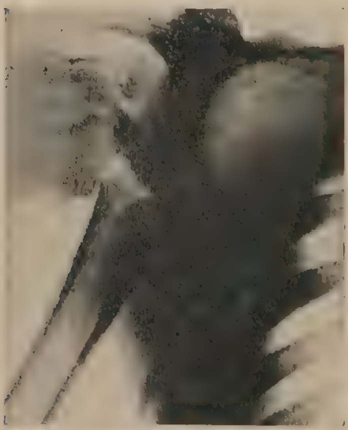

Fig. 230.—Fracture of the surgical neck of the humerus. Erroneously considered a dislocation of the shoulder by a practitioner who attempted to reduce it.

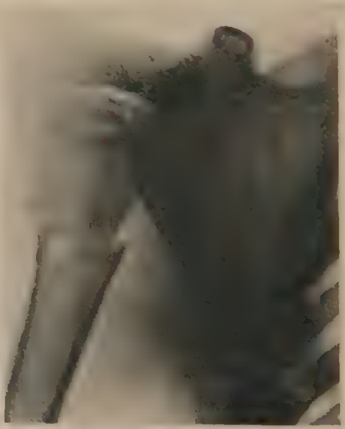

Fig. 231.—Fracture of the surgical neck of the humerus, shown in Fig. 230. Condition after reduction under full anesthesia.

sionally the aid of the fluoroscope may be required. The arm is usually immobilized in a Velpeau dressing, but the aëroplane splint is sometimes indicated in older individuals (Figs. 228–235).

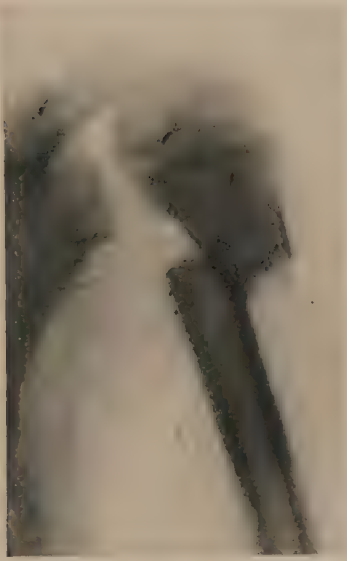

Fig. 232.—Fracture of the surgical neck of the humerus.

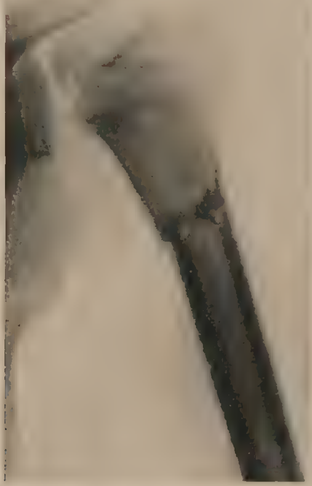

Fig. 233.—Fracture of the surgical neck of the humerus shown in Fig. 232 after reduction.

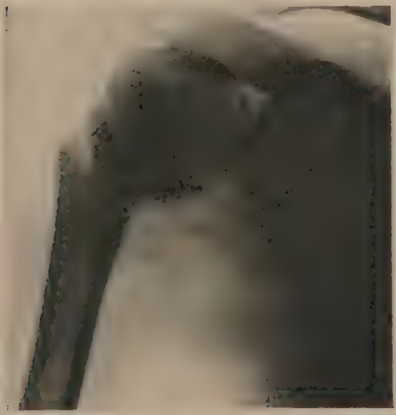

Fig. 234.—Fracture of the surgical neck of the humerus.

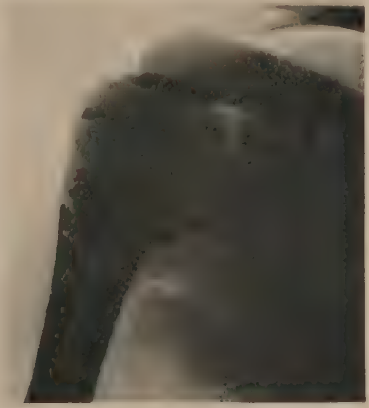

Fig. 235.—Fracture of the surgical neck of the humerus shown in Fig. 234 after reduction.

5. *Complete Fracture of the Shaft of the Humerus.*—Because of the difficulties attendant upon reduction, because of the frequency of non-

union, because of the likelihood of musculospiral nerve involvement, and because of the difficulty of proper immobilization, cases of complete fracture of the shaft of the humerus belong to the realm of major surgery.

6. *Fissure Fractures of the Lower End of the Humerus.*—Transverse and linear vertical fissure fractures of the lower end of the humerus without displacement of the fragments are properly treated by immobilization in a sling with early mobilization and heat.

7. *Fractures of the Condyles of the Humerus.*—The internal and external epicondyles of the humerus may be fractured by falls upon the elbow or outstretched hand. Occasionally the fragment may be displaced to a considerable distance from the shaft. Efforts to replace the displaced fragments should be made by manipulation. In this type of fracture immobilization in the Jones position of hyperflexion in a sling or in a posterior molded plaster-of-Paris splint, with the institution of early motion, and heat will effect a cure.

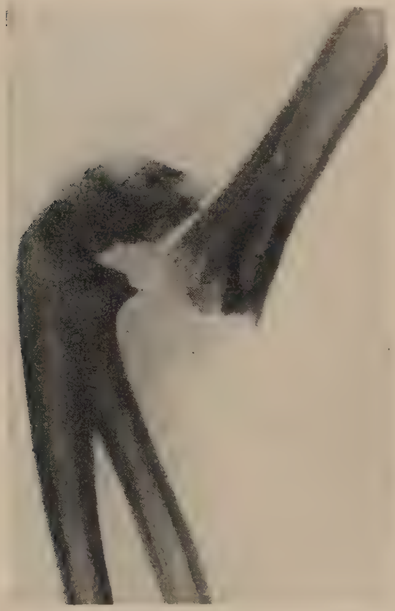

Fig. 236.—Fracture of the lower end of the humerus.

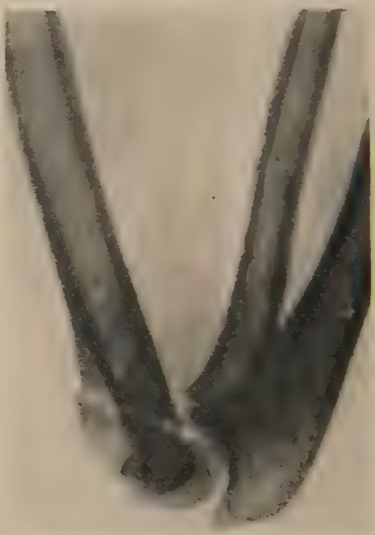

Fig. 237.—Fracture of the lower end of the humerus shown in Fig. 236 after reduction. Note that the elbow is held in the Jones position of hyperflexion, in which the triceps tendon acts as a very efficient splint.

8. *Fractures of the lower end of the humerus* commonly occur after falls upon the hand, particularly in children. The shaft may be broken

above or through the condyles. One or both condyles may be partly or completely fractured. There may be a vertical fissure extending upward from the joint.

The diagnosis is generally obvious from the deformity, pain, loss of use, history, swelling, and ecchymosis, but *x*-ray should never be omitted. Reduction should only be attempted under full anesthesia. Where there is not a great amount of swelling the accuracy of the reduction may be determined with considerable certainty by palpation, but it is best to attempt the reduction in the fluoroscopic room where the assistance of the fluoroscope may be obtained if desired. After reduction the arm is put up in the Jones hyperflexion position. The tense tendon of the triceps acts as a very efficient splint to hold the fragments in position. In some cases, however, the hyperflexion position will cause an anterior angulation of the distal fragment. In all cases an *x*-ray examination will be made after reduction (Figs. 236-244). The position of hyperflexion may be maintained by several strips of adhesive across between the forearm and arm. This adhesive is well padded so as not to cut into the skin. Occasionally the swelling at the elbow becomes so great that an obstruction to the circulation occurs and the forearm must be lowered. The attendants should be cautioned to observe most carefully the temperature, pulse, and sensation in the affected hand. When walking the flexed arm may be carried in a sling, but when sitting or lying it is best elevated on a pillow to diminish the tendency to swelling.

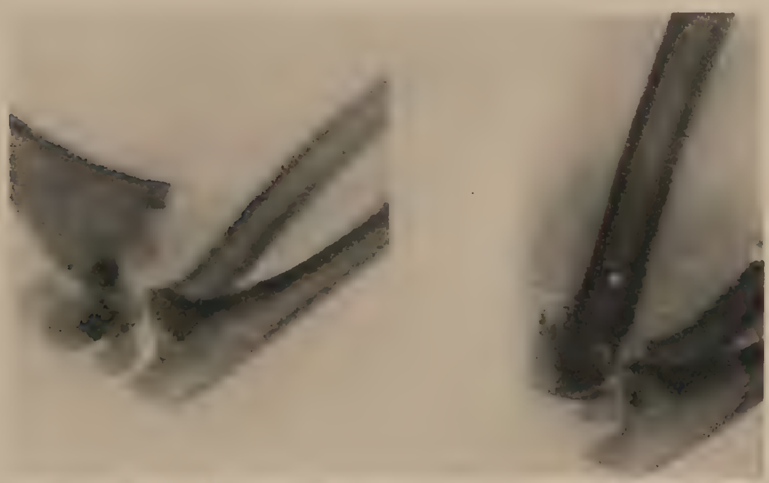

Fig. 238.—Fracture of the lower end of the humerus. Before and after reduction.

Allison[1] believes that the "Lund swathe" is the best method for general use of securing hyperflexion. The swathe is described as fol-

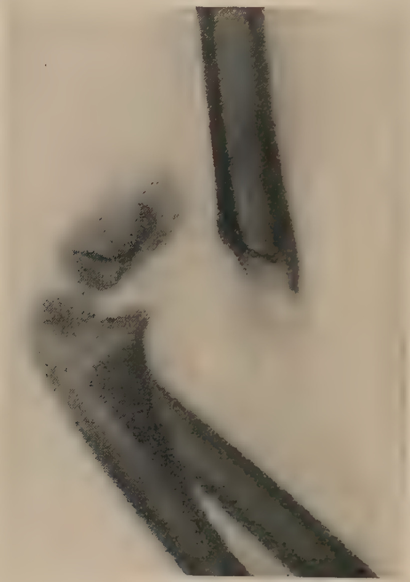

Fig. 239.—Fracture of the lower end of the humerus.

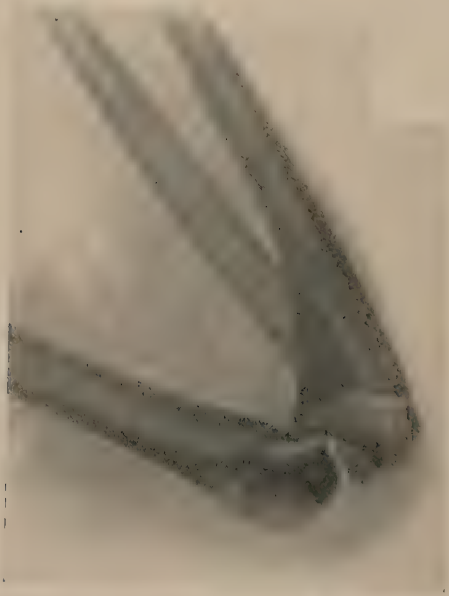

Fig. 240.—Fracture of the lower end of the humerus, shown in Fig. 239 after reduction

lows[1]: "A cotton swathe of the width of the shoulder, and long enough to make a figure-of-8 around the elbow and body, is passed under the flexed elbow horizontally, its center being at the point of the el-

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[1] Allison, Nathaniel: Jour. Amer. Med. Assoc., 89, 1568, November 5, 1927.

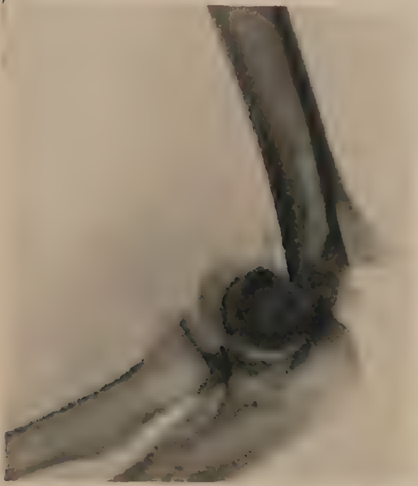

Fig. 241.—Severe fracture of the lower end of the humerus.

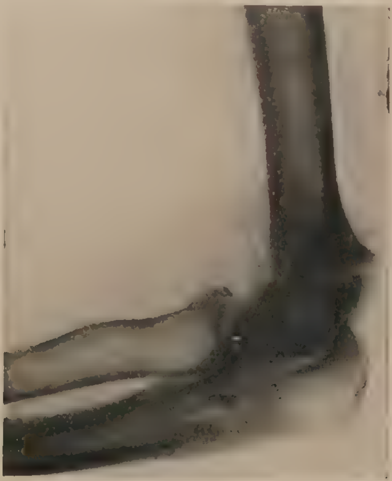

Fig. 242.—Fracture of the lower end of the humerus shown in Fig. 241 after reduction.

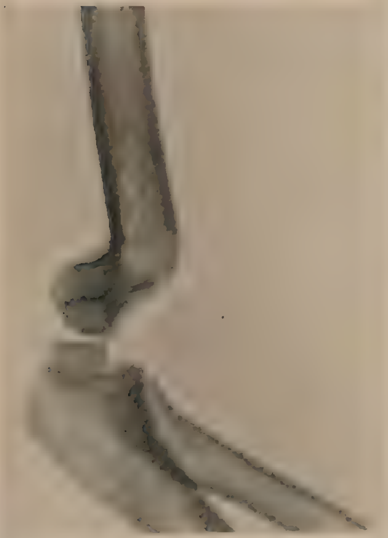

Fig. 243.—Greenstick fracture of the lower end of the humerus.

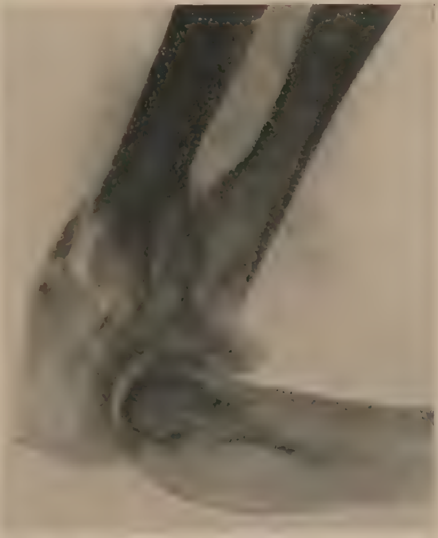

Fig. 244.—Severe comminuted fracture of the proximal ends of the radius and ulna.

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[1] Lund, F. B.: Boston City Hospital Report, 1897, quoted by Allison.

bow. The proximal end is carried snugly up around the forearm and over the shoulder, and the distal brought forward around the arm, across the front of the chest, and under the opposite arm. It is pinned to the end which has been brought over the shoulder, behind the back of the patient" (Figs. 245–248).

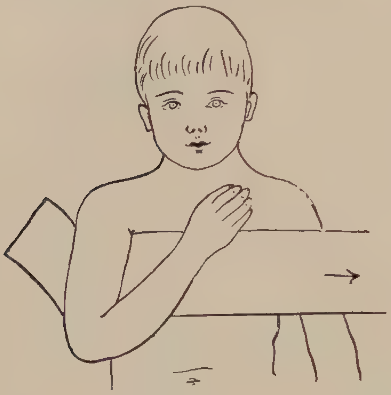

Fig. 245.—The Lund swathe. A strip of muslin the width of the shoulder is passed under the arm and across the chest; two persons hold the swathe. (Allison, Nathaniel, Jour. Amer. Med. Assoc., November 5, 1927.)

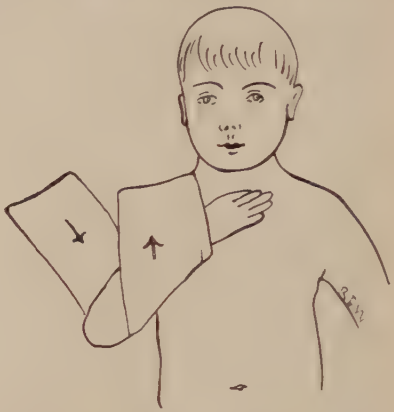

Fig. 246.—The Lund swathe. One end is then brought under the forearm and over the shoulder. (Allison, Nathaniel, Jour. Amer. Med. Assoc., November 5, 1927.)

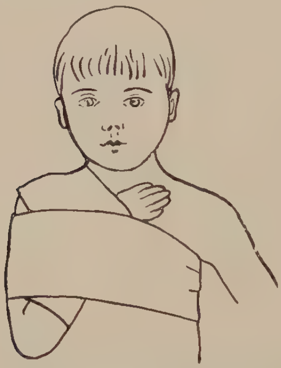

Fig. 247.—The Lund swathe. The other end is then passed around the body. (Allison, Nathaniel, Jour. Amer. Med. Assoc., November 5, 1927.)

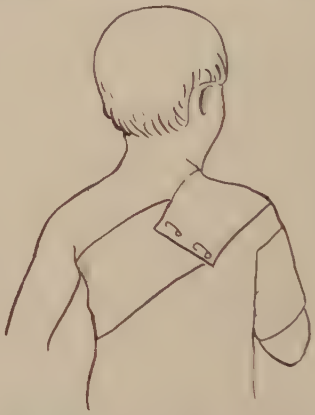

Fig. 248.—The Lund swathe. The two ends are securely pinned back of the shoulder. It is well to pad the end of the elbow with cotton and to powder the axilla and skin surfaces with talcum powder. (Allison, Nathaniel, Jour. Amer. Med. Assoc., November 5, 1927.)

9. *Epiphyseal Separation at the Lower End of the Humerus.*—The diagnosis of this lesion is generally only possible by *x*-ray. It most

frequently occurs in children. The treatment is reduction under anesthesia and immobilization of the elbow in acute flexion for a period of some two weeks. After that the forearm is gradually lowered and heat and active motion are instituted. Gentle massage may be of value. In discussing after-treatment of elbow fractures Hansson and Birrell[1] say that "massage and passive motion of the elbow are contraindicated because they are unphysiological and may produce myositis ossificans or, at least, excessive callus. Early application of heat and active motion to the injured part promotes early functional restoration." Where the elbow is stiff after elbow fractures forcible "pump-handle" treatment should never be employed. Active motion and heat are the proper course (Fig. 249). Diathermy will be found to be extremely useful. Gentle massage *below* the joint, but not above it, will be of value.

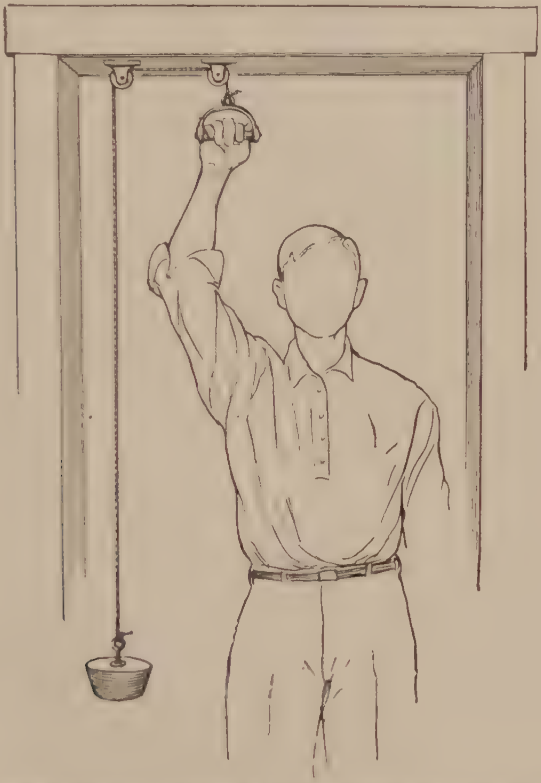

Fig. 249.—Simple method of regaining scapulohumeral or elbow motion by patient's own efforts. (From Forrester's "Imperative Traumatic Surgery," published by Paul B. Hoeber, Inc.)

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[1] Hansson, K. G., and Birrell, R. G.: American Jour. Surg., 3, 13, July, 1927.

(c) *Minor Fractures of the Radius and Ulna.*—(1) *Impacted Fractures of the Head of the Radius.*—This very common injury, which is the result of falls upon the outstretched hand, which transmits violence upward along the shaft of the radius, is very commonly overlooked. The diagnosis is made from the history of the type of the fall, of the elicitation of a tender point at the head of the radius which is aggravated by supination and pronation and by the *x*-ray examinations (Figs. 250, 251). The pain in these cases may be very marked for the first twenty-four hours, and is relieved by cold applications to the elbow and by the administration of sedatives. Supporting the forearm in a sling for a week or ten days and the early employment of

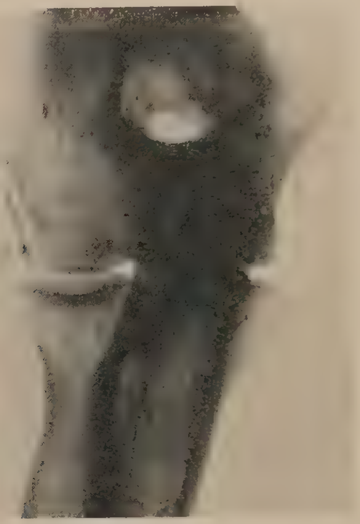
Fig. 250.—Impacted fracture of the head of the radius.

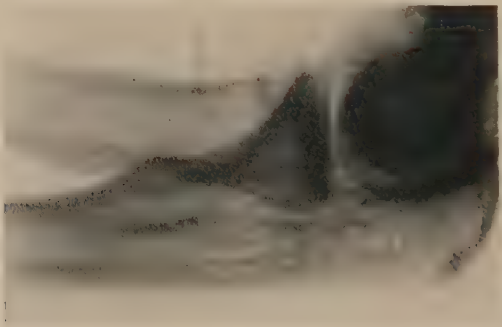
Fig. 251.—Impacted fracture of the head of the radius.

active and passive motion, heat, and massage will bring about a cure in three to four weeks.

2. *Fractures of the Coronoid Process of the Ulna.*—Fracture of the coronoid process of the ulna occurs almost exclusively as a complication of dislocation of the elbow. The treatment is immobilization in a sling for two weeks with the early use of heat and massage and guarded active motion.

3. *Complete Fracture of the Head of the Radius.*—In very young children complete fracture of the head of the radius with displacement may successfully be treated by manipulation, relatively short immobilization, heat, and massage (Figs. 252, 253). In adults complete fracture of the head of the radius is a major surgical problem. Union is infrequent, and ankylosis of the elbow is a not uncommon sequel. According to Speed, the fractured head should be removed by operation.

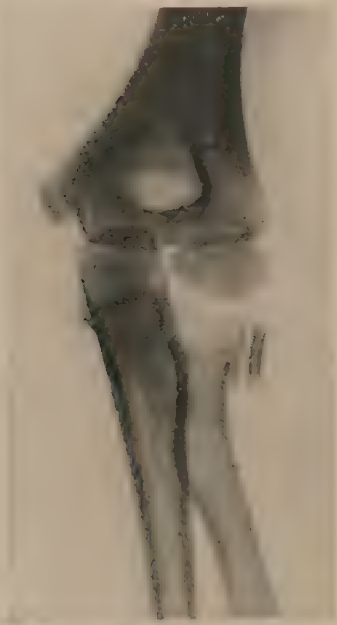

Fig. 252.—Fracture of the head of the radius in a child of six. Lateral displacement.

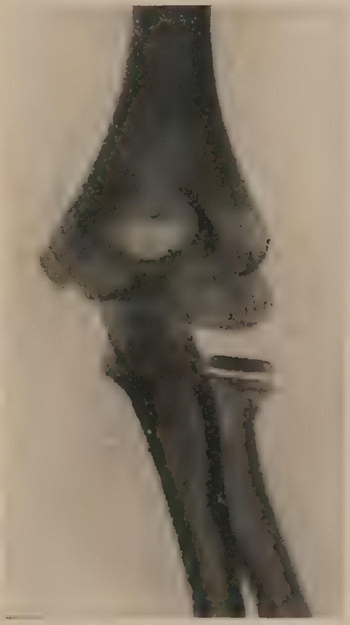

Fig. 253.—Fracture of the head of the radius shown in Fig. 252 after reduction.

4. *Incomplete Fracture of the Shaft of the Radius and Ulna.*—These may be of the *fissure* variety or the *greenstick* type. In the former immobilization with a wood or molded plaster-of-Paris splint for three

or four weeks is all the treatment that is required. The splint will be removed twice weekly, at which time the forearm will be soaked in warm water, bathed with alcohol, and dusted with talcum powder, and the adjacent joints will be manipulated (Fig. 254). In the *greenstick* type the bowing deformity will be gently corrected under anesthesia, using all possible precautions to prevent the production of a complete fracture (Fig. 255). These fractures are best immobilized by means of anterior and posterior molded plaster-of-Paris splints for a period of three or four weeks, and in the case of young active children a longer time will not be disadvantageous. As in the case of fissure fractures the splints will be removed two or three times weekly, the arm bathed in hot water, dried, dusted with talcum powder, and the adjacent joints given extremely careful active and passive motion.

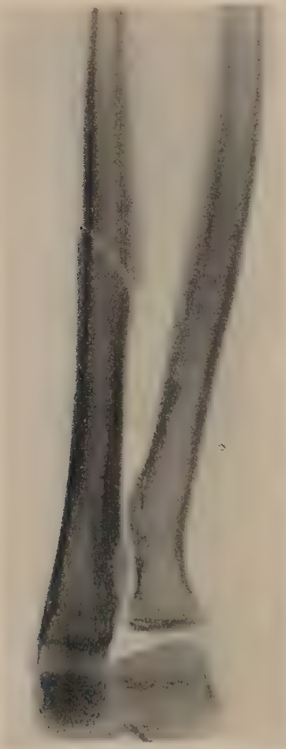

Fig. 254.—Subperiosteal fracture of the shaft of the ulna.

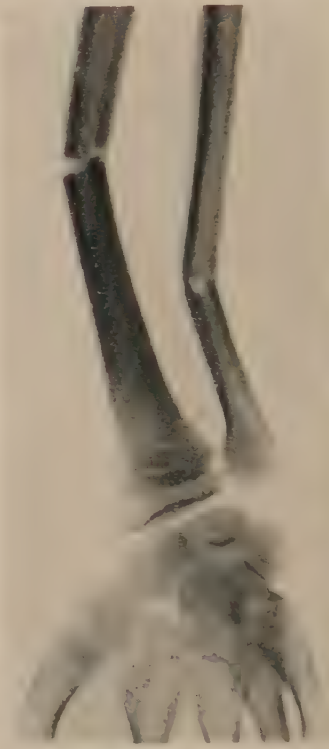

Fig. 255.—Greenstick fracture of both bones of the forearm.

5. *Colles' Fracture.*—Fractures of the distal end of the radius may be of numerous types, and a great volume of very valuable literature has been accumulated upon this subject, to which the reader must

necessarily be referred for rare or complicated cases. The average case of fracture of the distal end of the radius (Colles' fracture), however, is of such common occurrence and, moreover, is so generally treated by the first physician to whom the injury is brought that it will seem wise to include it in minor surgery. Fractures of the distal end of the radius are most frequently incurred by falls upon the outstretched hand. Notwithstanding the fact that nature had abundantly enlarged this portion of the radius to withstand the many shocks to which it is subject, nevertheless the distal end of the radius is, next to the ribs, the bone most frequently fractured. By a Colles fracture generally is meant a transverse fracture of the distal end of the radius an inch or less proximal to the wrist joint. The distal radial fragment is displaced posteriorly, giving rise to the characteristic "silver-

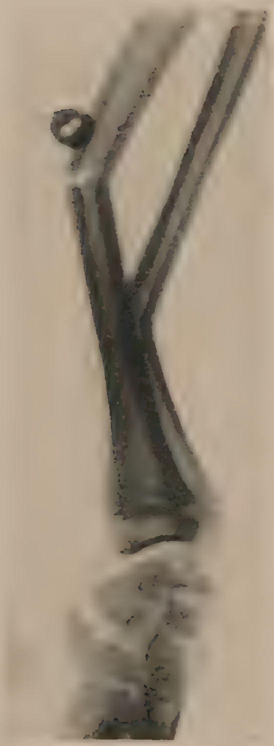

Fig. 256.—Greenstick fracture of both bones of the forearm. Lateral view of case shown in Fig. 255.

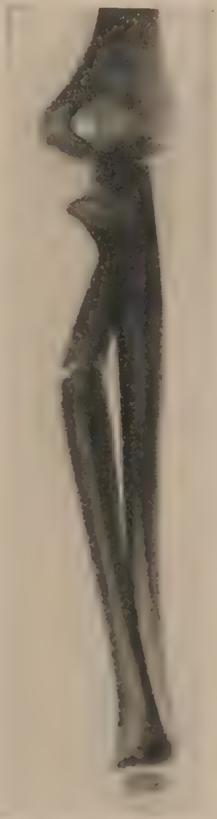

Fig. 257.—Transverse fracture of shaft of radius.

fork" deformity of the wrist (Fig. 265). A very common accompaniment to fracture of the distal end of the radius is a fracture of the tip of the styloid process of the ulna. Fractures extending to the wrist joint—Barton's fractures, reverse Barton's fractures—are different from Colles' fracture and the treatment is somewhat more difficult.[1] In some cases of Colles' fracture there is no displacement of the fragment; in others the fragments are impacted. Cases with impaction or without displacement of the fragments are recognized by the history of a fall, by the existence of a tender point on the bone, and by the *x*-ray examination (Figs. 266–268). The treatment is immobilization for fourteen to twenty days on a wooden or molded plaster splint, with fre-

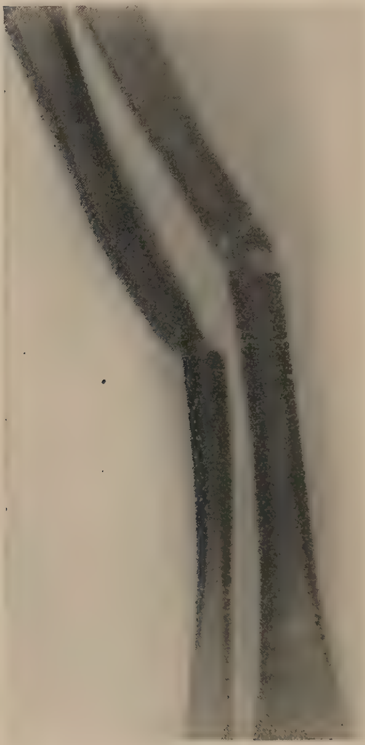

Fig. 258.—Complete fracture of both bones of the forearm. Gentle straightening of the arm is all that is required for reduction. Rough manipulation will convert this injury into a complicated fracture with overriding of the fragments.

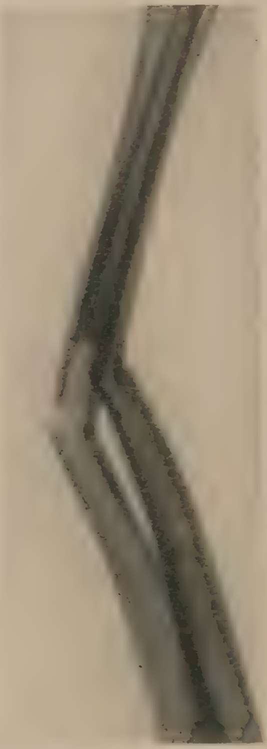

Fig. 259.—Lateral view of fracture shown in Fig. 258.

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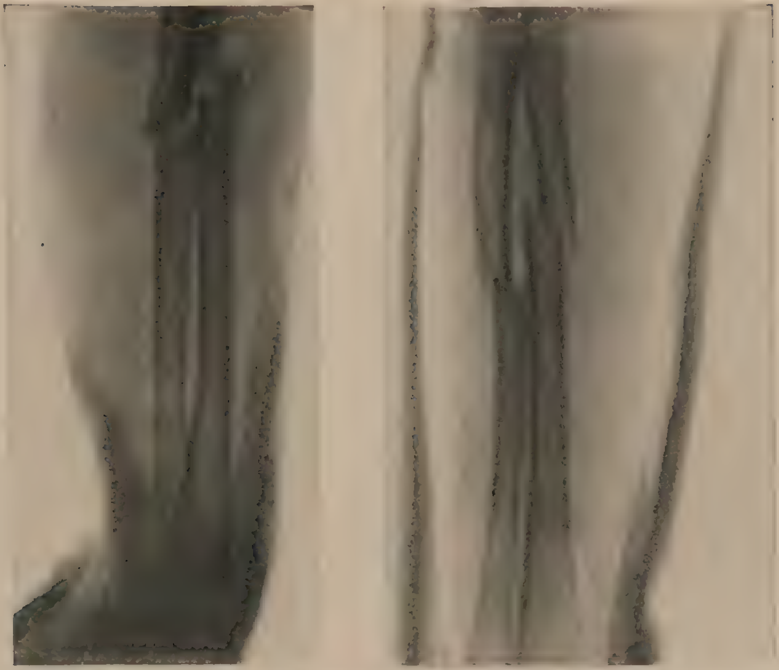
[1] Christopher, Frederick: Reversed Barton's Fracture, Jour. of Bone and Joint Surgery, 9, 502, July, 1927.



Figs. 260, 261.—Fracture shown in Figs. 258 and 259 after reduction and incorporation in molded plaster splints.

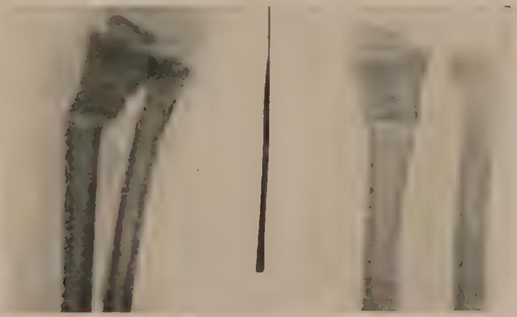


Fig. 262.—Greenstick fracture of the lower end of the radius.

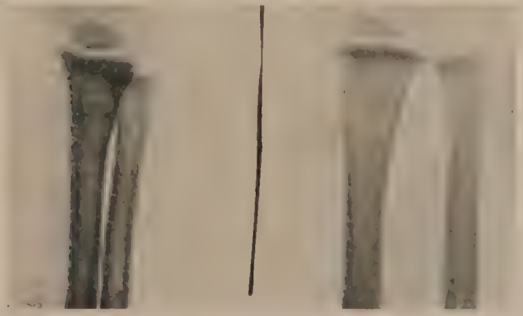


Fig. 263.—Fracture shown in Fig. 262 after reduction.

quent massage and heat, with active and passive motion during and after this time.

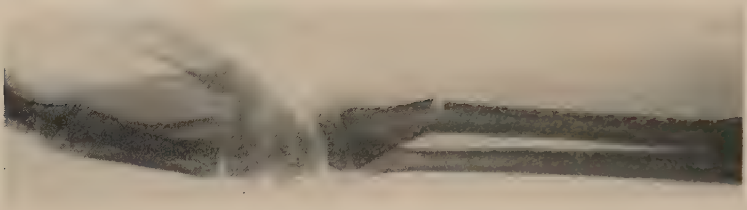


Fig. 264.—Greenstick fracture of the lower end of the radius.

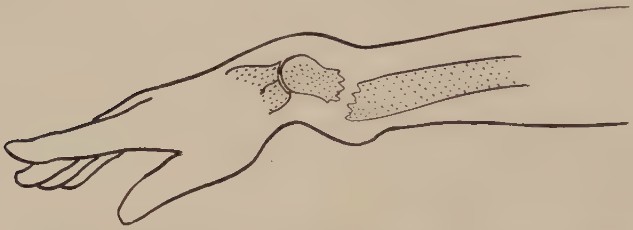


Fig. 265.—Characteristic "silver-fork" deformity in Colles' fracture.

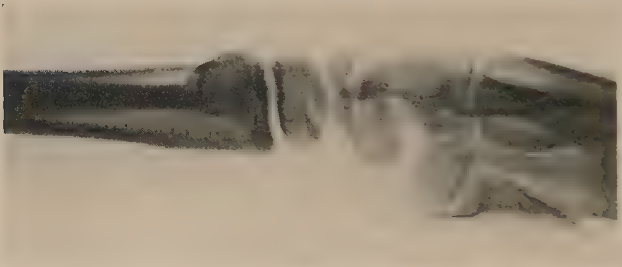


Fig. 266.—Impacted fracture of the lower end of the radius. "Sprain fracture."

Fig. 267.—Impacted fracture of the lower end of the radius.

In a recent Colles' fracture the diagnosis will readily be made by the appearance of the wrist alone. In the later cases where the swelling has become marked and the silver-fork deformity somewhat obliterated,

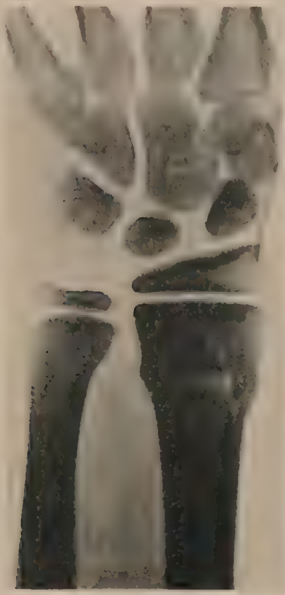


Fig. 268.—Impacted fracture of the lower end of the radius.

careful palpation of the bone will elicit the displacement of the fragments. An *x*-ray examination will decide the question (Figs. 269–284).

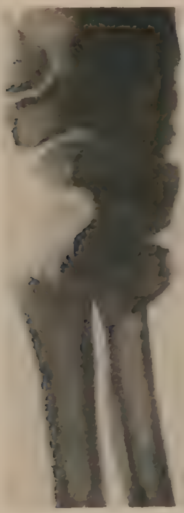


Fig. 269.—Colles' fracture with marked displacement of distal fragment.

Fig. 270. Condition of fracture shown in Figure 269 after reduction

All Colles' fractures should be reduced as soon as possible. An *x*-ray examination will first be made and the patient then placed under general anesthesia. Unless there is a severe impaction with the displacement the reduction may be effected by one person alone. Rarely two people will be required to break up the impaction. The hand of the injured wrist is then grasped by the hand of the surgeon in such a manner that the thumb will press on the distal fragment on the dorsal surface. The patient's hand is then tipped backward in extreme flexion, putting strong pressure and some traction on the distal fragment. In this manner after a few efforts it will generally be possible to move the distal fragment back into its normal position. It is extremely desirable to secure, if possible, an exact anatomical reposition of the fragments. After reduction has been effected the surgeon will repeatedly and painstakingly palpate the surface of the injured

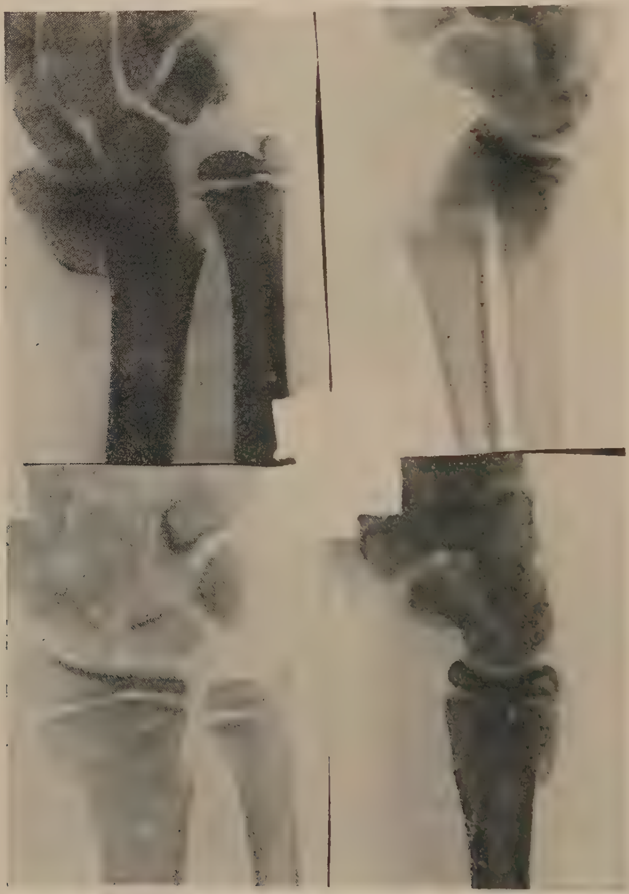


Fig. 271.—Colles' fracture. Above: condition before reduction. Below: condition after reduction.

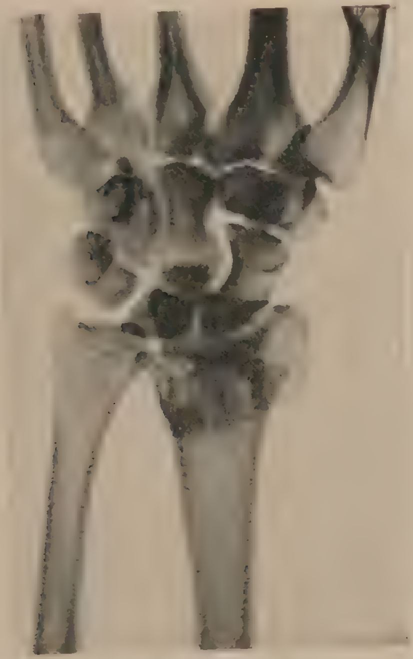


Fig. 272.—Colles' fracture with displacement of the distal end of the radius.

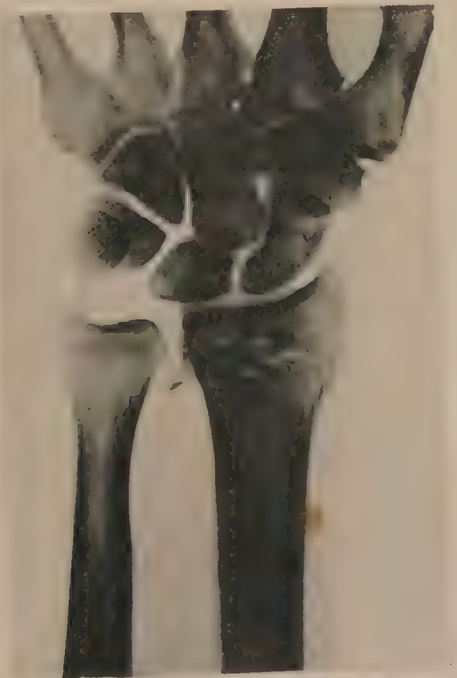


Fig. 273.—Condition after reduction of fracture shown in Fig 272.

bone to assure himself as accurately as possible that the reduction is satisfactory. Where the distal fragment is somewhat shattered, and exact reposition may be difficult, it is important to place it in such a position that the articular surface of the distal end of the radius is inclined slightly downward toward the palmar surface. After reduction has been attained and has been demonstrated to be satisfactory by

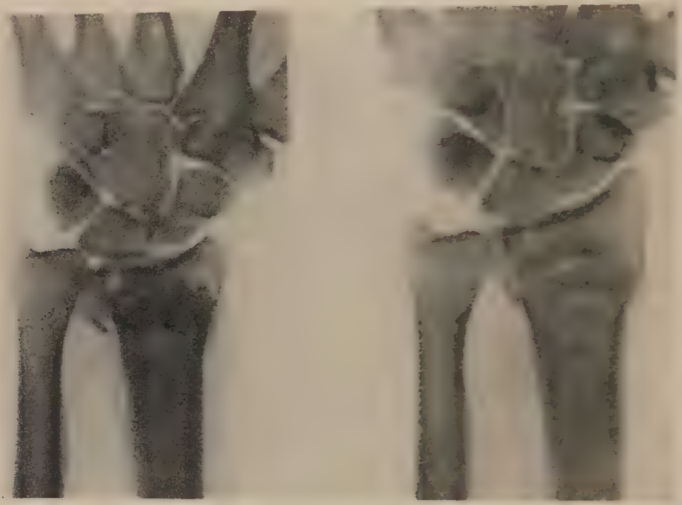


Fig. 274.—Colles' fracture. Condition before and after reduction.

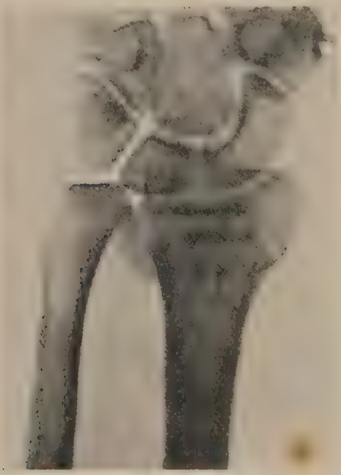


Fig. 275.—Colles' fracture with displacement of the distal end of the radius.

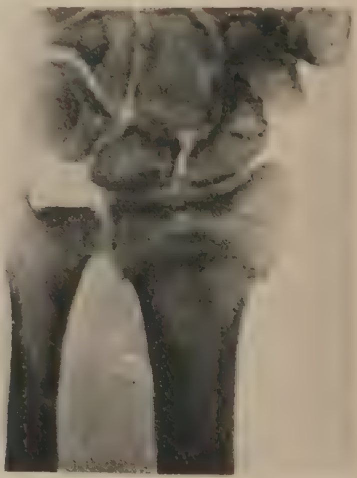


Fig. 276.—Condition after reduction of fracture shown in Fig. 275.

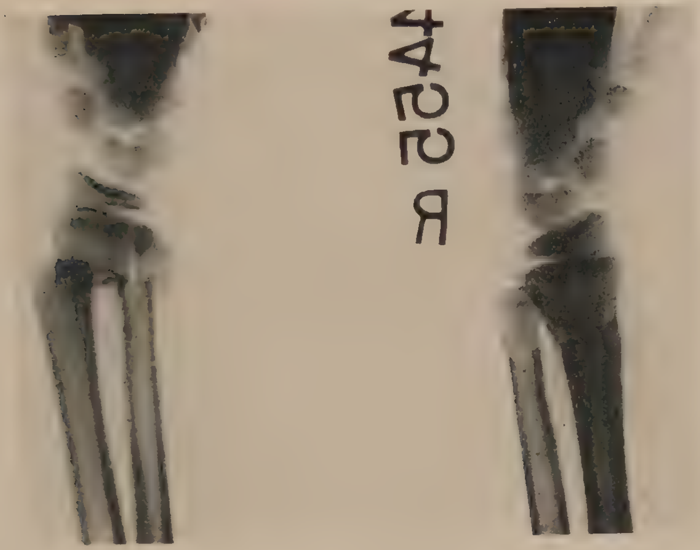


Fig. 277.—Colles' fracture. Condition before and after reduction.

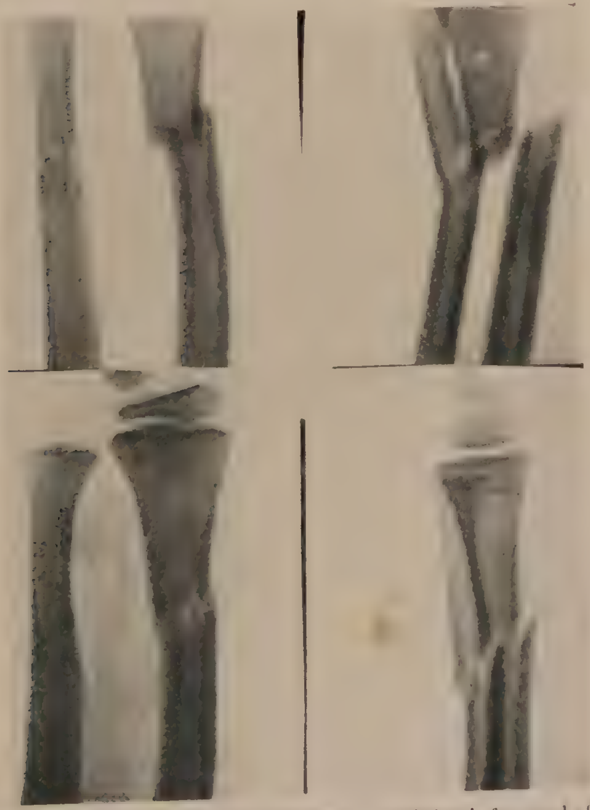


Fig. 278.—Fracture of both bones of the forearm. Condition before and after reduction.

the x-ray, immobilization will be instituted. Should the reduction not seem proper in the x-ray, a second or even third effort should be made. The best methods of immobilizing a reduced Colles' fracture is the employment of anterior and posterior molded plaster-of-Paris splints. These splints will extend from the metacarpophalangeal junction to a point ½ inch below the elbow (see Fig. 287). They shall be of such length as not to interfere with the action of the elbow-joint nor with the flexion of the fingers. The molded splints are made by

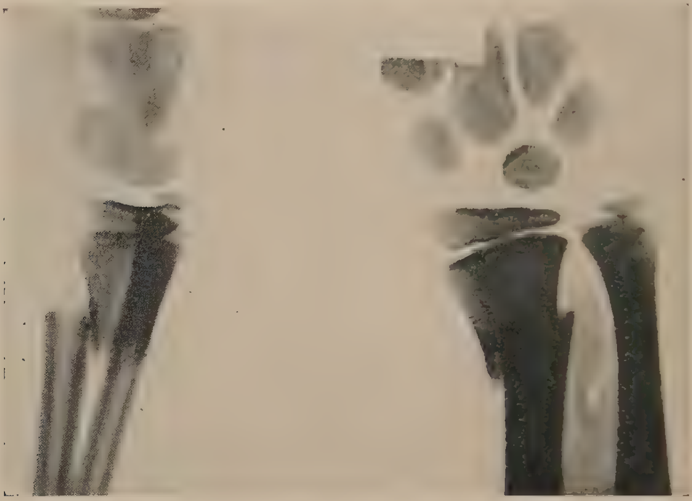


Fig. 279.—Fracture of the lower end of the radius.

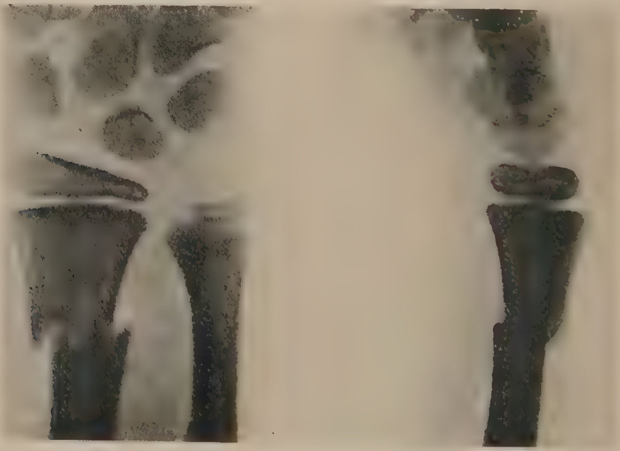


Fig. 280.—Anteroposterior and lateral views of fracture shown in Fig. 279 after reduction.

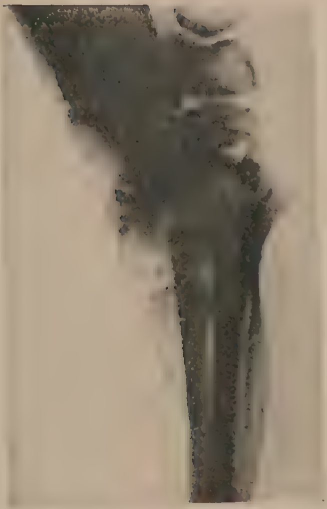


Fig. 281.—Severe Colles' fracture with displacement of fragment of radius into palm of hand.

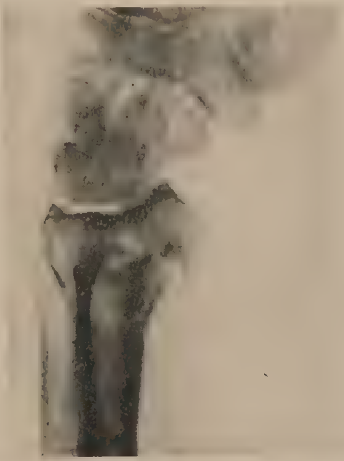


Fig. 282.—Condition after reduction of fracture shown in Fig. 281.

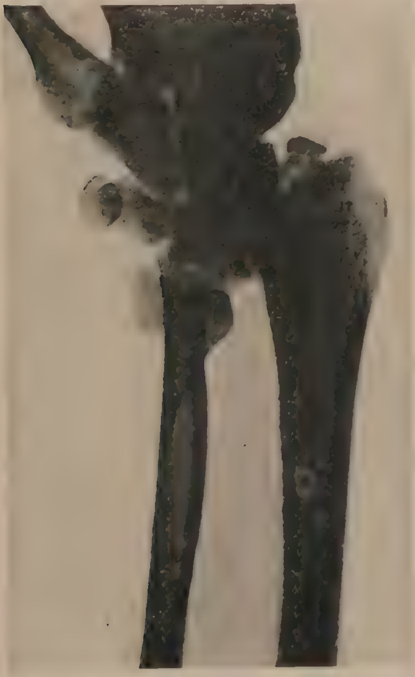


Fig. 283.—Severe Colles' fracture with dislocation of radial fragment.

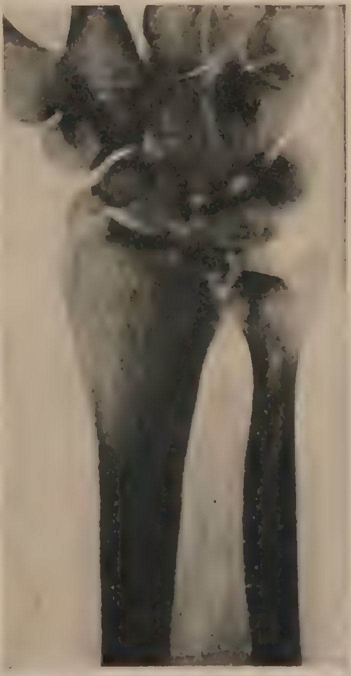


Fig. 284.—Condition after reduction of fracture shown in Fig. 283.

an assistant who folds back and forth the different layers of rough plaster-of-Paris bandage on a flat surface until a plaster gauze mass $\frac{1}{4}$ inch in thickness and the correct length is obtained. It will generally be advisable before the application of the splints to place over the injured forearm a sleeve of stockinet. This is accomplished with least danger of disturbing the fragments by unrolling it on the arm (Figs. 285, 286). The first molded splint will then be applied to the dorsal surface of the palms and forearm (Fig. 290). It is important that it be put in place before it has begun to set. If it has begun to set and is somewhat stiff, it should be discarded and a fresh plaster-of-Paris splint made. The soft plaster-of-Paris splint may be now smoothly bandaged to

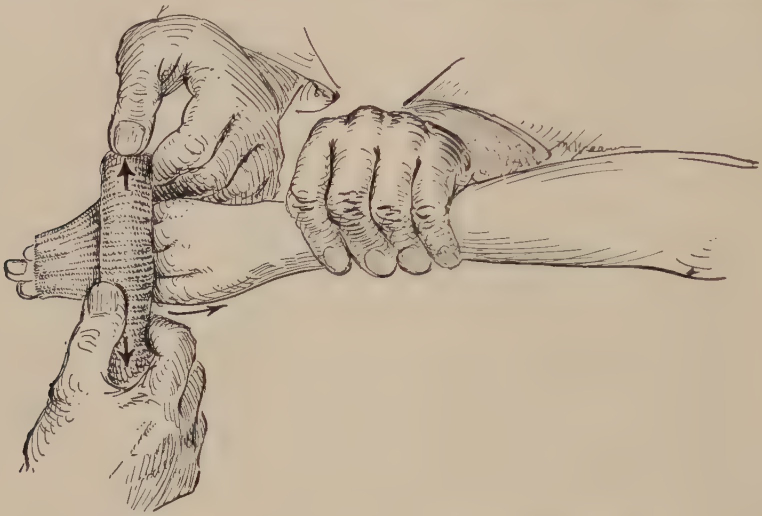


Fig. 285.—Method of applying stockinet to fractured arm.

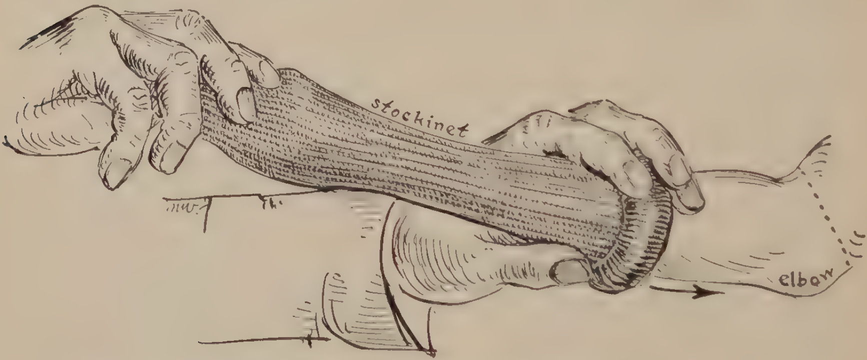


Fig. 286.—A further step in the method of applying stockinet to a fractured arm.

the hand, wrist, and forearm with one or two thicknesses of thin gauze bandage. The extremity is then held in a position of slight eversion

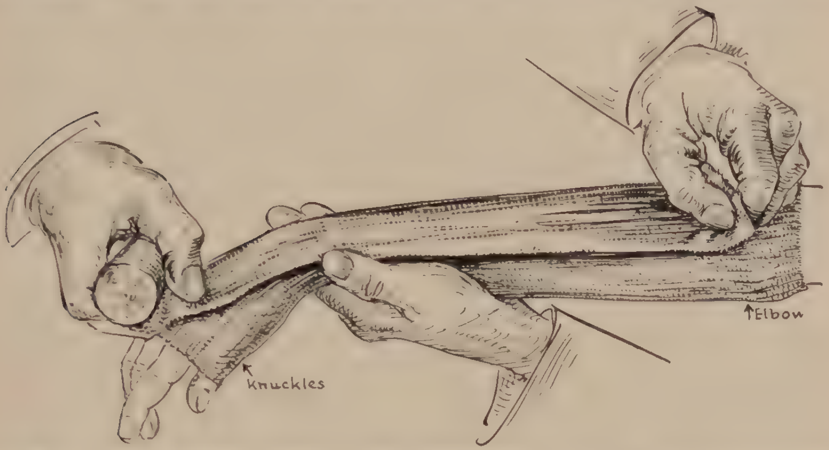


Fig. 287.—Determination of length to make molded plaster splint. The splint should not be so long as to impair the movement of the fingers or elbow.

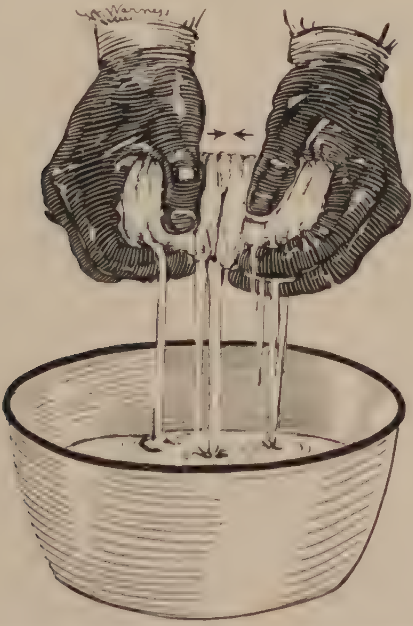


Fig. 288.—Method of expressing excess water from a plaster-of-Paris bandage.

of the hand with palmar flexion (Fig. 292) until the plaster has set. When this has occurred, the volar molded splint will be applied and bandaged in the same manner (Fig. 291). It is important not to grasp the extremity while the plaster is hardening in such a manner as to cause indentations in the plaster. When the plaster dries such indentations will cause painful projections into the arm. When both splints have thoroughly hardened, it will be wise to remove them to trim any ragged edges of plaster at the ends and to place between them and the affected extremity one or two layers of cotton sheet wadding. The splints now receive their final circular bandage, which is best made of gauze. It is applied snugly, but not too tightly. The splinted extremity is

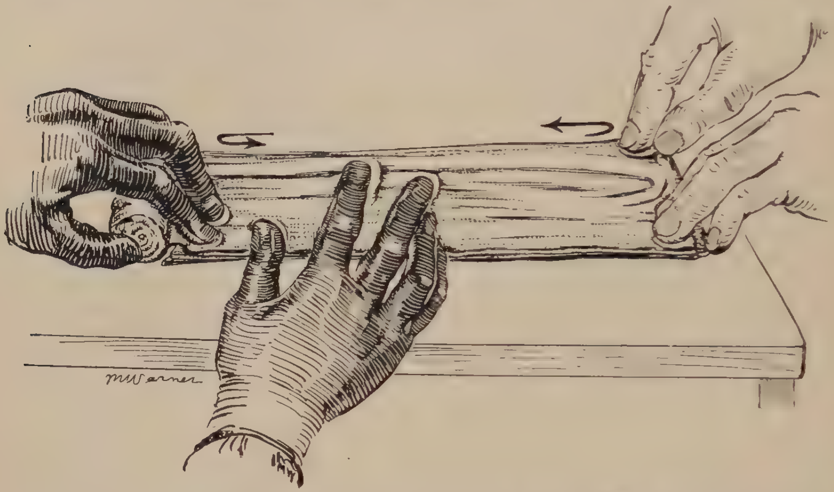


Fig. 289.—Method of preparing molded plaster splint. The plaster bandage is turned back and forth upon itself until the desired thickness is obtained. The separate layers are thoroughly rubbed.

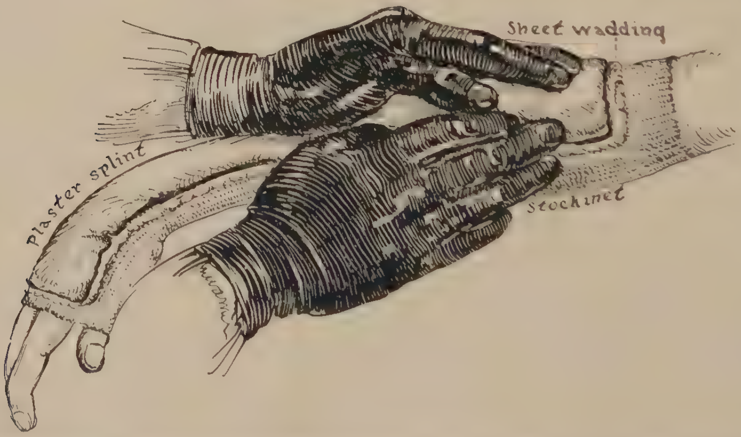


Fig. 290.—Method of molding the soft wet plaster splint to the contours of the forearm.

placed in a sling so adjusted that the wrist is an inch or two higher than the elbow. The patient is instructed on his return home to put his arm

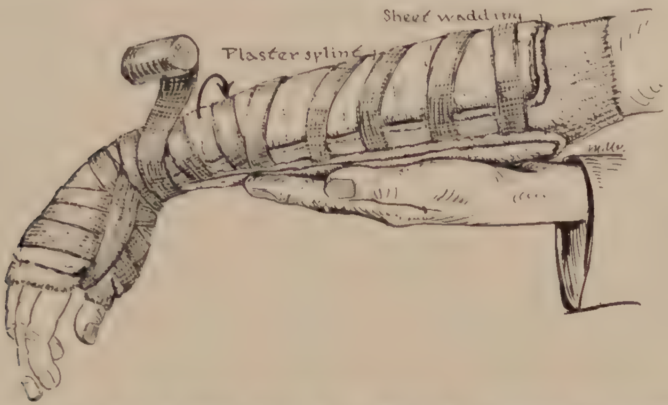


Fig. 291.—The soft molded splints are carefully and smoothly bandaged to the arm. One may be bandaged in place before the other is applied, as is shown in the figure.

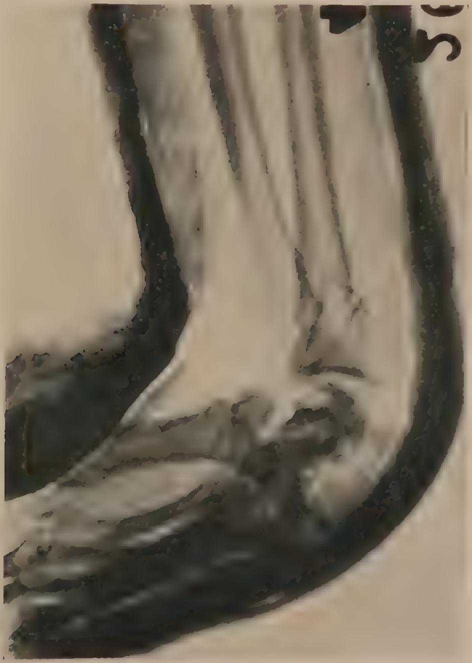


Fig. 292.—Colles' fracture after reduction, incorporated in molded plaster-of-Paris splints. The hand is held in the position of volar flexion.

out to the side on a pillow on the table in such a manner that the wrist will be elevated as high as convenient. During sleep the wrist is best placed on a pillow. The patient will from time to time move the fingers and thumb by active motion. He will be warned that he will experience considerable pain and will be provided with aspirin, codeine, or other sedative, to allay this pain. It is extremely important that he be given detailed instruction for the recognition of more than ordinary swelling between the splints. The danger of extreme swelling and consequent tightness of the bandage of causing consequent ischemic contraction is well known. The pain under such circumstances changes from a steady ache to a severe and intolerable discomfort. The fingers, in which slight swelling is permissible, will become markedly swollen. The fingers, moreover, may become cool and will have a sensation of numbness. They may be cyanotic in appearance. Should these symptoms appear and the patient acquaint the surgeon of their appearance, it will behoove the latter to visit him as soon as possible, no matter what time of day or night. The bandages will be slit down the sides, releasing the pressure,and the molded splints will be rebandaged. As the normal swelling subsides from day to day it will be necessary to take up the slack in the bandages by the application of fresh, tighter ones. Beginning the third or fifth day, physiotherapy will be started, and this will best be carried out, if possible, by the surgeon himself. The dorsal splint will first be removed and the skin of the extremity exposed. The extremity will be gently stroked for four or five minutes in accordance with the directions of Lucas-Championnière and of Mennell. This stroking will best be accompanied by bathing the skin in alcohol. The skin will then be dried and thoroughly dusted with talcum powder and the dorsal splint replaced. The wrist will then be turned over and, supporting it in the dorsal splint, the palmar splint will be removed and a similar procedure will be carried out. As a last step before rebandaging the wrist will be supported in the palmar splint, and with the dorsal splint removed gentle passive and active motions of the wrist-joint will be carried out. Such physiotherapeutic treatment should be done at least three times a week, preferably four. After the second week the treatments, which now include daily or bidaily soaking in warm water, may be delegated to an intelligent member of the household. At the end of the third week all splints will be removed and the patient will be encouraged to use his wrist freely in mild exercises which do not require much strength. In many cases a leather wrist-strap or leather wrist-support (Fig. 293) will be very acceptable to the patient.

6. *Fractures of the Carpus.*—Fractures of the carpal bones, while much more rare than Colles' fracture, are still not unusual. Linear

fractures without displacement of any of these bones, the scaphoid most frequently being involved, are best treated, in contradistinction to Colles' fracture, by prolonged mobilization. After the initial swelling has subsided a snug-fitting, circular plaster-of-Paris cast will be applied, and not removed for four to six weeks. Where there has been a complete fracture of a carpal bone with displacement of a fragment, it generally will be necessary to remove the fragment or fragments in entirety. In discussing fractures of the carpal navicular (scaphoid) bone Speed[1] says that "in very early cases the treatment is immediate immobilization in slight radial and volar flexion for seven to eight weeks, followed by gradual motion and daily baking. In old cases, which have remained undiagnosed for a week or longer, carpalectomy of the navicular bone is the only satisfactory treatment. Cases of long standing with ankylosis may require removal of the entire proximal row." Johnson[2] says that in fractures of the carpal scaphoid the fragments have a sufficient blood-supply. There is no periosteal callus. The cartilaginous surface heals by fibrous tissue formation. This worker found no evidence of lytic effect of the joint fluid on bone repair. The prognosis in fractures of the os triquetrum is favorable. Eilers,[3] who has made a study of this subject, says that the

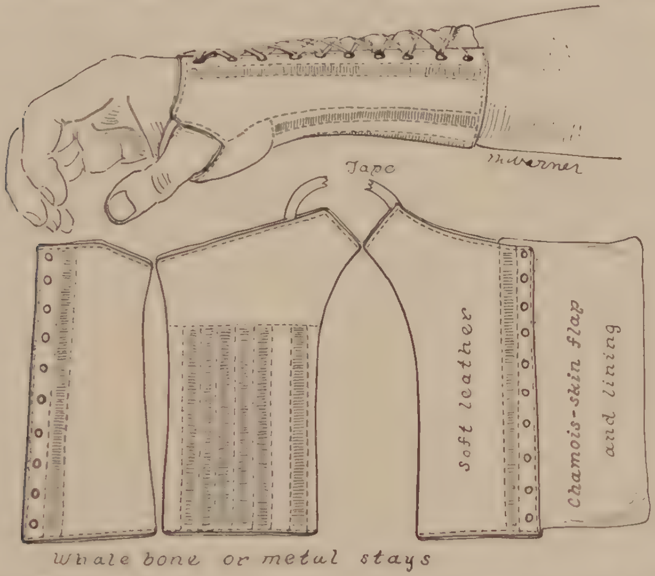


Fig. 293.—Reinforced leather wristlet for use in the after-care of Colles' fracture.

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[1] Speed, K.: Jour. of Bone and Joint Surgery, 7, 682, 1925.

[2] Johnson, R. W., Jr.: Jour. of Bone and Joint Surgery, 1927, 9, 482.

[3] Eilers, O.: Deutsche Ztschr. f. Chir., 1927, 206, 141.

treatment is simply rest followed by physiotherapy. The open operation necessary to do this belongs to the realm of major surgery.

(*d*) *Kienboch's Disease of the Semilunar Bone.*—In this condition there is a traumatic nutritional disturbance with atrophy involving the semilunar bone. It is an isolated osteitis or destructive process with fragmentation. A characteristic feature of this ailment is the absence of a severe enough trauma to account for the disability. A diagnosis of sprain or rheumatism is frequently made. Speed[1] says: "The pathology probably depends upon interference with the blood-supply which arrives at the bone via the ligaments. When a slight trauma is received the ligaments may be torn, the bone nourishment is interrupted, and the absorption begins. Primary fracture often causes the same results because of the impeded vascular supply and the poor osteogenetic properties of the bone. The condition is characterized by local pain and tenderness and wrist-joint disability. According to Goldsmith[2] "there are four stages to the syndrome, each merging gradually with its successor. The first stage, that of joint irritation immediately following trauma, is comparatively short, generally persisting not more than one or two weeks. There follows a period of relative freedom from discomfort lasting several months. This is followed by the actual disease stage with more severe symptoms. Finally, after several months, the acute symptoms subside into a stage of moderate disability which, as well as the *x*-ray findings, remains unchanged for years." The diagnosis is made by the history, the physical examination, but principally by the *x*-ray. The pain is aching, annoying, and on excessive use of the wrist, quite severe. There is tenderness over the semilunar bone with usually slight swelling and a moderate degree of restriction of motion (Henderson[3]). Buchman,[4] who terms Kienboch's disease a "traumatic osteoporosis," calls attention to the fact that the *x*-ray examination is at first negative. The prognosis is unfavorable unless the treatment advocated and so successfully employed by Webb[5] is carried out. This author removed all the fragments of the semilunar bone under general anesthesia through a palmar incision of the wrist. One of his patients returned to his work as a section hand two months after the injury (Figs. 294, 295).

(*e*) *Fractures of the metacarpals* occur following blows upon the knuckles, falls upon the hand, or by direct violence. The third metacarpal has been broken by a fall on the outstretched middle finger. The third and fourth are most commonly broken. A Bennet's fracture is an oblique intra-articular fracture of the base of the first metacarpal. The palmar half is separated and the balance is displaced somewhat backward, giving the appearance of a subluxation. Bressot[1] reports 12 cases of the various types of fractures of the base of the first metacarpal. He says that the oblique extra-articular fractures and the Bennet's intra-articular fractures both heal with a 10 to 15 per cent.

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[1] Speed, Kellogg: Fractures and Dislocations, 2d ed., Lea & Febiger, 1928, p. 517.

[2] Goldsmith, Ralph: Annals of Surgery, 81, 858, April, 1925.

[3] Henderson, M. S.: Jour. of Bone and Joint Surgery, 1926, 8, 504.

[4] Buchman, J.: Annals of Surgery, 87, 892, 1928.

[5] Webb, Roscoe C.: Annals of Surgery, 84, 763, November, 1926.

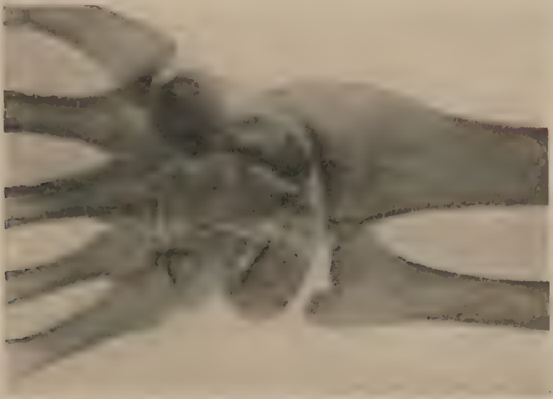

Fig. 294.—Chronic osteitis of the semilunar bone, Kienboch's disease, showing fragmentation of the diseased semilunar bone following slight injury. Treated by excision of the semilunar bone. Returned to full duty two months following operation. Recovery complete. (Case of Dr. R. C. Webb.)

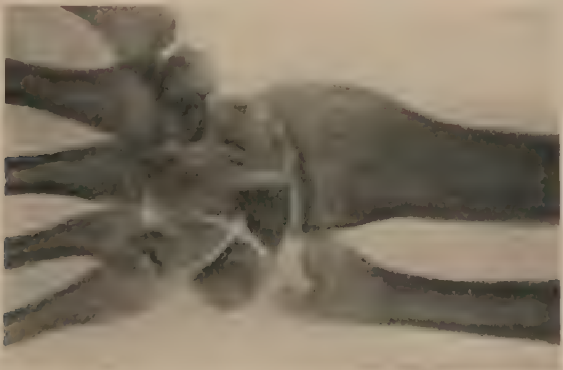

Fig. 295.—Chronic osteitis of the semilunar bone, Kienboch's disease, showing the increased density of the bone and diminished size. Complete recovery and return to full duty as coal-shute operator three months following operative removal of the semilunar bone. (Case of Dr. R. C. Webb.)

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[1] Bressot: Bull. et mem. Soc. de Chirugiens de Par., 1926, 18, 425.

incapacity. On the transverse extra-articular type there is no displacement and the prognosis is good. These fractures are generally oblique and the diagnosis is made by the history, pain, inability to use fingers, the point of tenderness, the swelling, and the *x*-ray. The anatomy and physiology of the fractures have been emphasized and so lucidly described by Magnuson[1] that one can do no better than to quote from his paper: "In the case of the metacarpals there are attached on each side of each metacarpal the interosseus muscles which originate along the base and shaft on each bone and are attached anterior to the midline on the base of the first phalanx. These muscles are used constantly as flexors, and, as a matter of fact, are flexors which do their jobs unusually well for twenty-four hours a day, and in persons who use their hands in more or less hard tasks during a considerable part of each day these muscles attain no mean strength. With the muscles acting as flexors, but at the same time pulling almost in the long axis of the bone, traction on the distal end of the bone is considerable in the effort to flex the distal fragment. If the fracture is oblique, there is a shortening plus a flexion. If the fracture is transverse and the ends are brought into good reposition, then the effect is only that of flexion. This produces angulation of the shaft, the angle pointing directly backward toward the dorsum, because the muscle balance on the two sides of this bone is equal. The angle backward does two things: it makes the extensor tendons run around two sides of a triangle instead of straight across the back of the bone, and it throws the distal head of the bone into the palm of the hand and shortens the bone, which results in a prominence in the palm of the hand over the ball, which throws an uneven pressure on that point when the patient grasps a hard substance after the fracture is healed (Figs. 296, 297). One might as well carry a marble in the palm of the hand between the handle of a tool and the head of the bone as to have the head of the bone protrude like a marble under the pad in the palm of the hand, which is so essential to comfort in lifting or handling hard objects. The flexion produced in the distal fragment produces

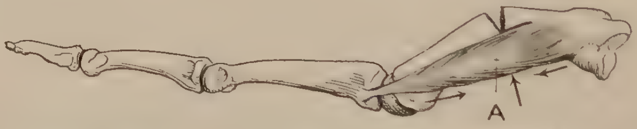

Fig. 296.—Diagram of mechanics of pull exerted by interosseus muscle (A). (Magnuson, P. B., Jour. Amer. Med. Assoc., November 3, 1928.)

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[1] Magnuson, Paul B.: Jour. Amer. Med. Assoc., 91, 1339, November 3, 1928.

flexion in the finger, so that the patient is either unable to bring the finger into full extension with the other fingers of the hand, or, if he does, it is necessary for him to hyperextend the metacarpophalangeal joint. He cannot bring the finger into full flexure because the callus on the back of the hand, as a result of the angulation of the metacarpal shaft, shortens the tendon and weakens the grip in this finger. When the inability of the patient to bear weight pressing into the palm of the hand because of the prominence of the distal head of the metacarpal is added to this, it is easy to see that a serious disability may result from an insignificant looking fracture in the shaft of the metacarpal." Reposition of the fragments may be obtained by bandaging the hand

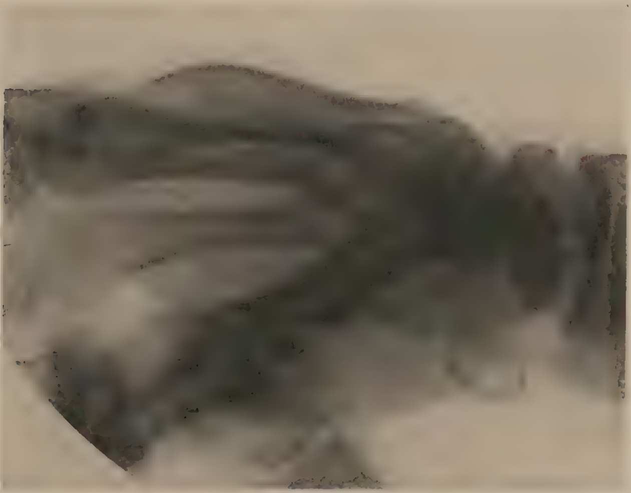

Fig. 297.—Healed fracture of first metacarpal, illustrating deformity produced by pull of interosseus; distal head of the bone thrown anteriorly into the palm of the hand, shortening the shaft; angulation of the fragment pointing dorsally over which extensor tendons must run. (Magnuson, P. B., Jour. Amer. Med. Assoc., November 3, 1928.)

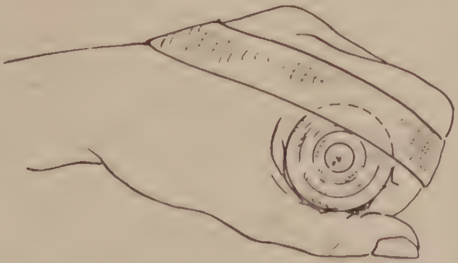

Fig. 298.—Roller bandage splint for fractures of the metacarpals and, in some cases, the phalanges.

with flexed fingers over a rounded object which fits the palm. For this purpose a roller bandage or the aluminum splints of Zimmer are admirable. The fingers are left free to permit some joint motion in cases where there is no displacement. In the cases where there is marked displacement it generally will be necessary to bandage the fingers down over the roller bandage or rounded splint in order to secure the reduction of the fracture (Fig. 298). Magnuson believes that the best method of treating this fracture is posterior splinting with a dorsal pad over the point of the fracture and palmar pad over the distal head. In some cases traction by one of the methods described under finger fractures may be necessary to insure proper position. Immobilization will be maintained for ten days to two weeks, after which it will be interrupted by periods of physiotherapy. An occasional unpleasant complication is the deviation of the extensor tendons due to the formation of the excessive callus.

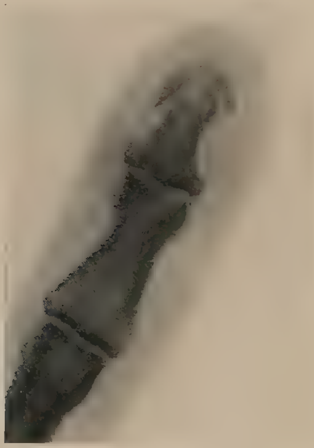

Fig. 299.—Comminuted fracture of the distal phalanx.

(*f*) *Fractures of the Fingers* (*Phalanges*).—(1) *Simple* fractures of the phalanges generally occur following blows upon the tips of the extended fingers, as from baseballs and the like. Crushing violence, as being caught between slammed doors, or the falls of heavy objects on the fingers, will cause fractures of the phalanges (Fig. 299). It is extremely important to the patient that these fractures be recognized and very accurately reduced. A boy presented himself to a physician some hours after being struck on the tip of the finger with a baseball. There was considerable swelling and tenderness in the region of the distal interphalangeal joint. The physician was able to elicit a certain amount of motion at this joint and, misled by the fact that the swelling obscured the outline of the finger, told the patient that it was all right and to do nothing about it. A month later this patient was referred to the writer because of a snugly bump at this joint. *x*-Ray examination (Fig. 300) showed that there had been a fracture of the distal end of the middle phalanx with displacement of the fragment almost half the width of the shaft. As will be seen in the figure, abundant callus had formed and the likelihood of benefiting the condition by refracture was extremely remote. This fracture, of course, should have been reduced when it occurred.

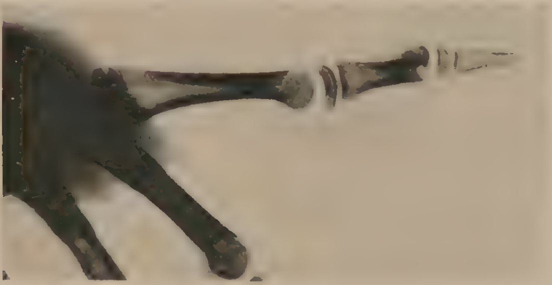

Fig. 300.—Unrecognized fracture of the middle phalanx of the index-finger. Was given no treatment by the practitioner who first saw it. The misplaced distal fragment may be seen to be strongly united by callus. The finger presents an unsightly deformity.

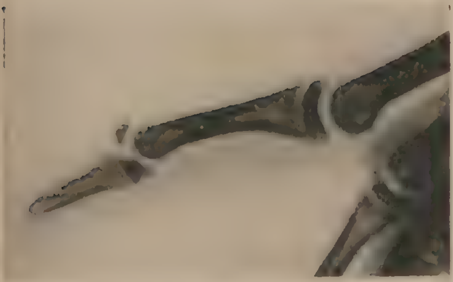

Fig. 301.—Lipping fracture of the distal phalanx.

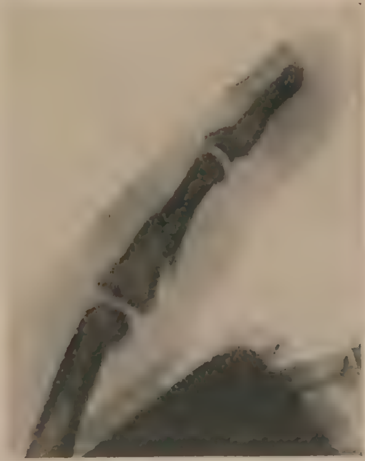

Fig. 302.—Fracture of the shaft of the middle phalanx.

Fractures of the phalanges (Figs. 301-303) are often difficult of treatment. Fractures of the base phalanges (Fig. 304) are particularly difficult because of the opposing action of the interossei and the lumbricales. The interossei flex the proximal fragment. "The lumbricales, however, which are attached to the fascia and the ligaments of the middle joint, act as extensors when that joint is dorsal to the midline. Whereas, if the joint is thrown forward they act as flexors of the base phalanx. In fractures of the shaft of the base phalanx, then, the interossei flex the base fragment and the lumbricales extend the distal fragment, which results in an anterior angulation of these fragments, which angulation throws the fractured surface of the bone against the surface of the flexor tendons (Fig. 305). If this deformity is not overcome there is union of these fragments with the distal end, and the distal half of the base phalanx in extension and with the proximal fragment of the base phalanx in flexion. The flexor tendons, which

Fig. 303.—Fracture of the shaft of the middle phalanx.

Fig. 304.—Fracture of the shaft of the proximal phalanx.

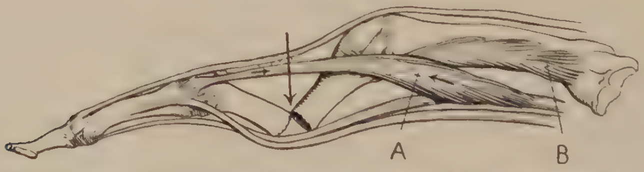

Fig. 305.—Diagram of pull of the lumbricalis muscle (*A*), illustrating extensor action of the distal fragment of the base phalanx with deformity produced with flexor tendon of the finger pushed forward by the fragments at point of fracture; *B*, interosseus muscle. (Magnuson, P. B., Jour. Amer. Med. Assoc., November 3, 1928.)

run over a knob of callus on the flexor surface of the base phalanx, interfere with the action of the tendon because of adhesions and of

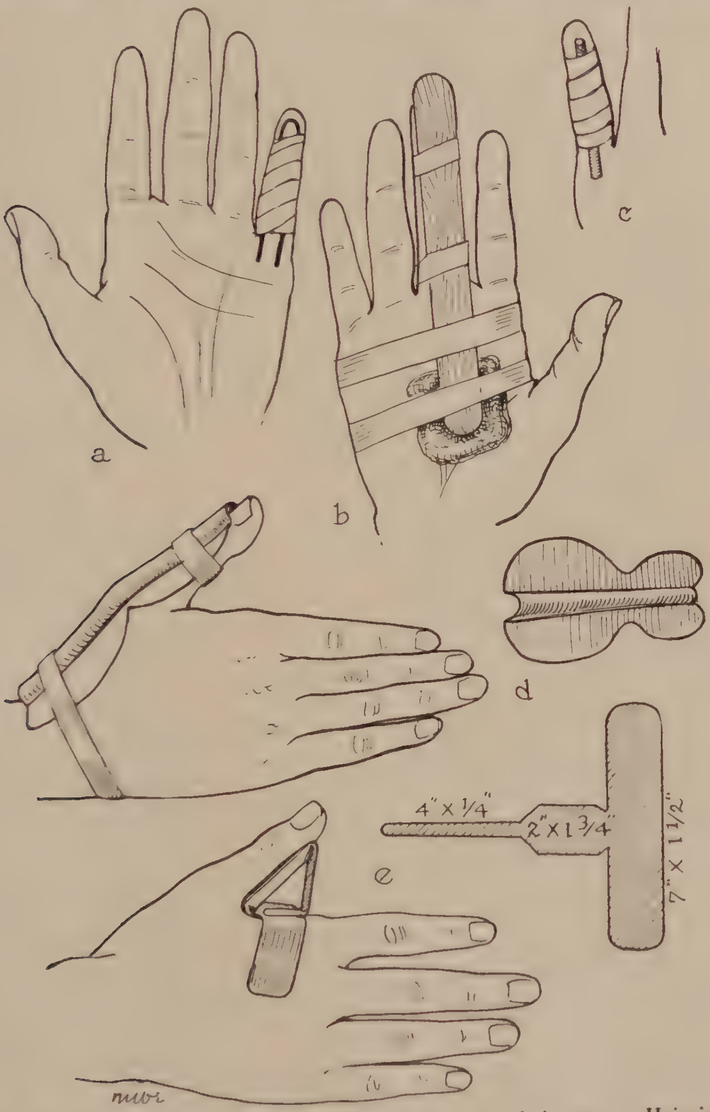

Fig. 306.—Various types of splints for fractures of the phalanges: *a*, Hairpin splint (after Moorhead). *b*, Tongue depressor splint. *c*, Copper wire splint (after Scudder). *d*, Gutter splint (after Cotton). *e*, Abduction thumb splint (after Goldthwaite, quoted by Cotton).

pressure. If the finger is flexed, the proximal half of the base phalanx can be brought into flexion, but the distal half of the base phalanx and the two phalanges are in extension so that the finger cannot be brought

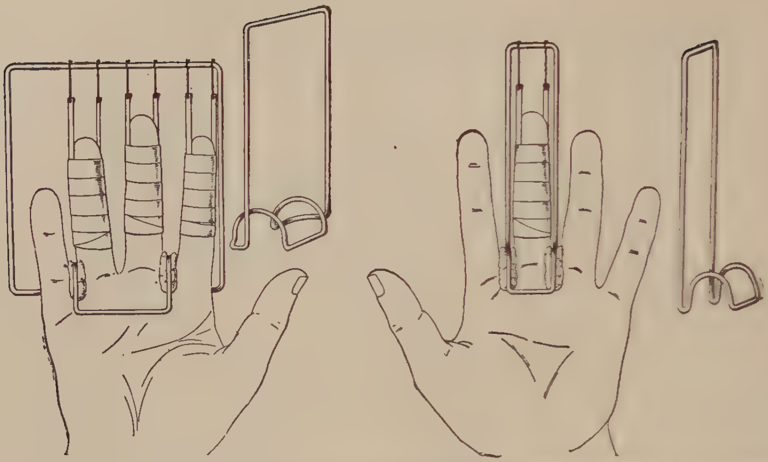

Fig. 307.—Traction splint for fractures of the phalanges. (Hawley, quoted by Scudder.)

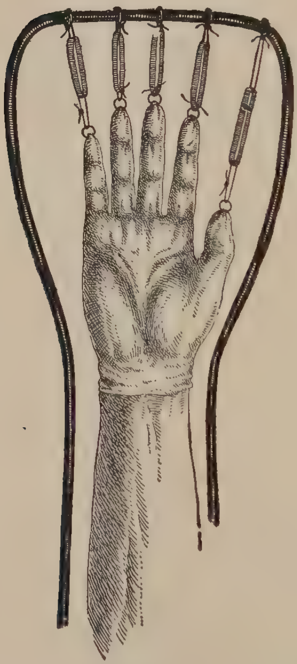

Fig. 308.—Blake traction splint for fractures of the phalanges. Cotton glove is glued to the hand and traction is made by rubber elastics. (Blake, quoted by Scudder.)

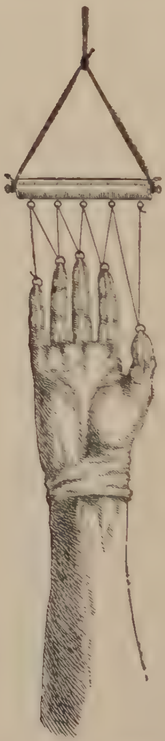

Fig. 309.—Blake traction splint for fractures of the phalanges. Rings are sewed to the fingers of a cotton glove which has been glued to the hand. Traction is obtained by a laced cord. (Blake, quoted by Scudder.)

to the point of contact with the palm, and when the person tries to lift a hard object he finds that the anterior angle at the point of fracture pinches the soft structures, namely, the tendons and skin, subcutaneously, between the angle of the bone and the hard object in the hand, and that he has lost part of his grip because of the inability of the flexor tendons to glide smoothly through their sheaths, plus the inability of the finger to close, because of hyperextension of its distal part. This weakens the grip and also gives pain.[1]

(2) *Compound.*—In cases of compound fractures of the phalanges where there is not sufficient disturbance of the circulation to cause gangrene of the portion of the finger distal to the injury, the wound will carefully be treated according to the methods described in the chapter on Wounds. The bandages will be so arranged that the wound may receive daily dressing without removal of the splint.

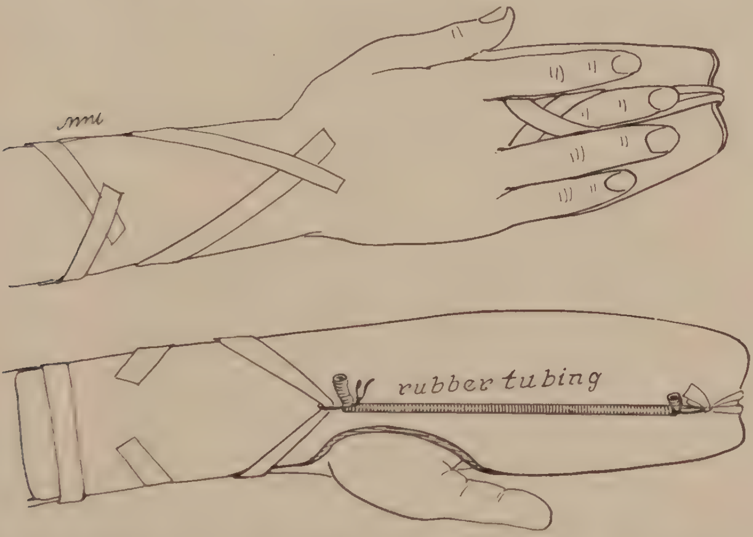

Fig. 310.—Elastic traction splint for fractures of the phalanges. (After Cotton.)

In fractures of the phalanges, reduction should be attempted and maintained, flexing the fingers over a palmar roller. A dorsal splint will often be successful (Fig. 306). Position should, of course, always be checked by x-ray. Where these methods fail, some type of traction should be instituted. Traction upon the finger may be obtained by adhesive (Figs. 307, 310), glue (Figs. 308, 309), small Steinman pin, or by finger-nail traction (Fig. 311), or specially devised finger caliper, both des-

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[1] Magnuson, Paul B.: Jour. Amer. Med. Assoc., 91, 1339, November 3, 1928.

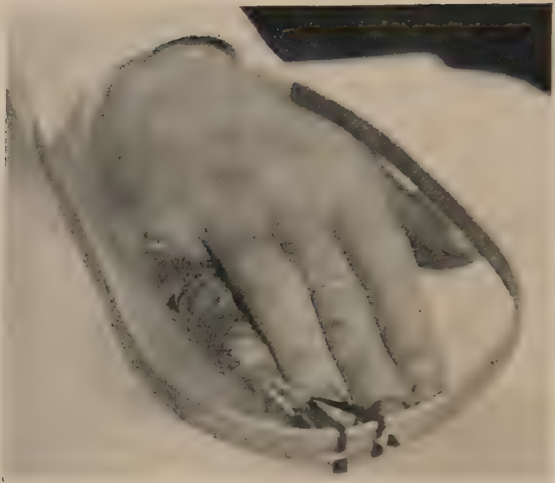

Fig. 311.—Method of applying extension through the finger nail. (Mock, H. E., and Ellis, J. D., Surg., Gynec., and Obst. October, 1927.)

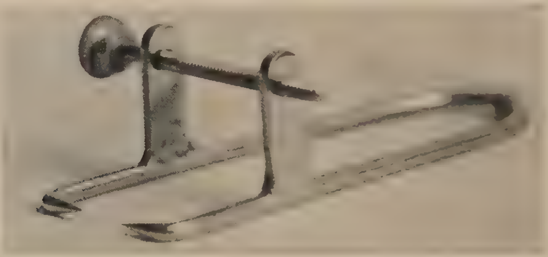

Fig. 312.—Metal finger caliper which can be applied to any phalanx or to the distal end of a metacarpal. (Mock, H. E., and Ellis, J. D., Surg., Gynec., and Obst., October, 1927.)

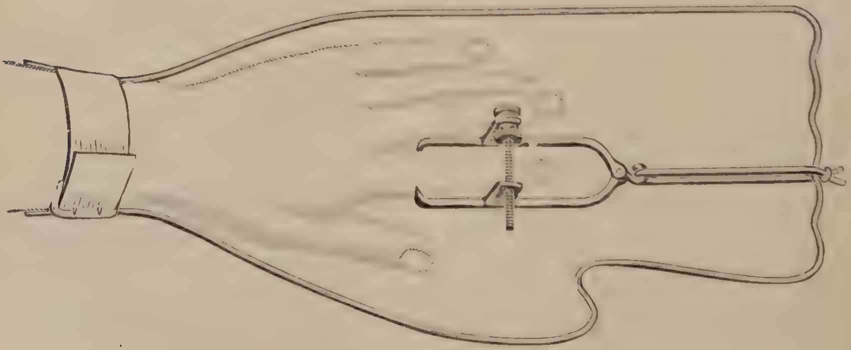

Fig. 313.—Metal finger caliper. (Mock and Ellis.)

cribed by Mock and Ellis[1] (Figs. 312, 313). The traction is attached by a rubber band or coil spring under proper tension (Mock uses as much as 8 ounces) to the extension piece of a Walker or "banjo" splint. The splint is made fast to the forearm. For fractures of the distal finger phalanges a dorsal projecting tongue-depressor splint is customary and efficient. The bent aluminum splint described by Ellis[2] (Fig. 314) is useful.

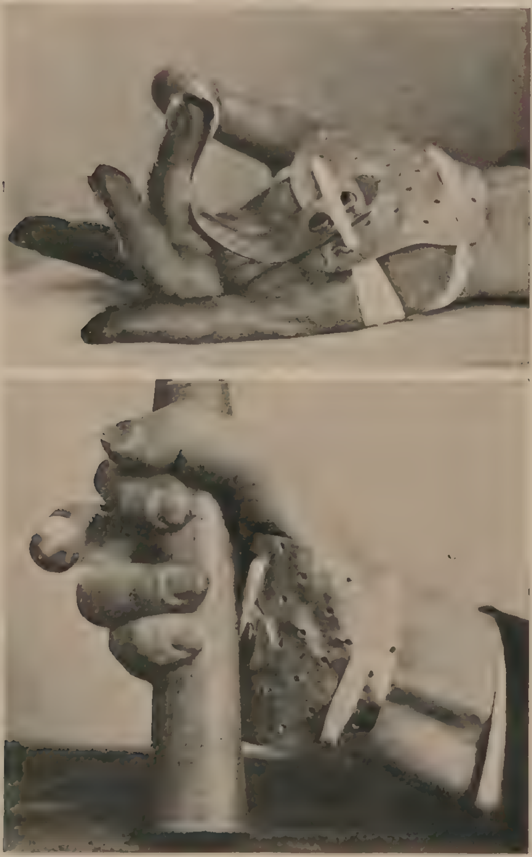

Fig. 314.—Bent aluminum finger splint. (Ellis, J. D. Amer. Jour. of Surg., November, 1928, Paul B. Hoeber, Inc., Publishers, N. Y.)

Dr. Sumner L. Koch, of Northwestern University Medical School, has devised a series of extremely ingenious and practical splints for the treatment of stiff joints of the wrist and fingers. These splints are shown in Figs. 315–318.[1] A very simple coaptation splint for immobilization of the thumb in abduction has been devised by Lester.[2] The preparation and application of this splint may readily be seen from the accompanying illustration (Fig. 319) from Lester's article.

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[1] Mock, Harry E., and Ellis, John D.: Surg., Gynec., and Obst., October, 1927, p. 551.

[2] Ellis, John D.: Amer. Jour. Surg., 5, 508, November, 1928.

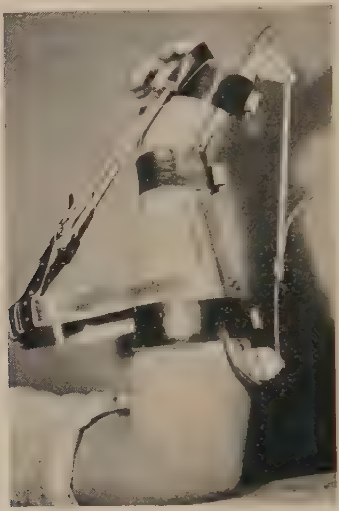

Fig. 315.—Corrective splint for stiff fingers and wrist. (Courtesy of Drs. S. L. Koch and M. L. Mason.)

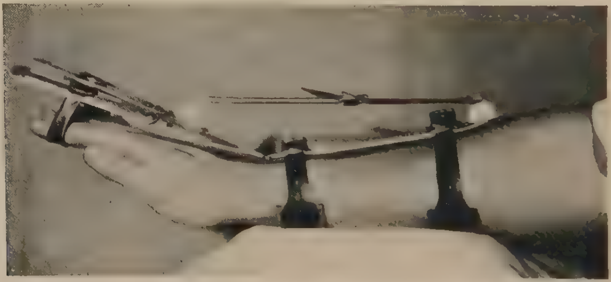

Fig. 316.—Corrective splint for stiff fingers and wrist. (Courtesy of Drs. S. L. Koch and M. L. Mason.)

(*g*) *Split Finger-nails.*—Carter[3] has suggested a treatment of the sometimes distressing condition of split finger-nail. The nail was permitted to grow $\frac{3}{8}$ of an inch beyond the finger. Three holes were then drilled in each side of the split in the nail, and the nail edges firmly

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[1] These splints may be obtained from the manufacturer, American Metal Ware Co., 368 West Huron Street, Chicago, Illinois.

[2] Lester, C. W.: Jour. Amer. Med. Assoc., vol. 91, July 14, 1928.

[3] Carter, W. W.: Jour. Amer. Med. Assoc., 90, 1619, May 19, 1928.

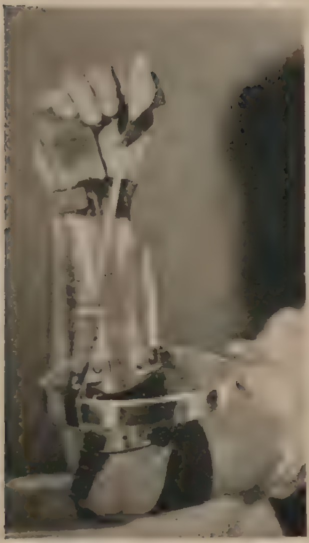

Fig. 317.—Corrective splint for stiff fingers and wrist. (Courtesy of Drs. S. L. Koch and M. L. Mason.)

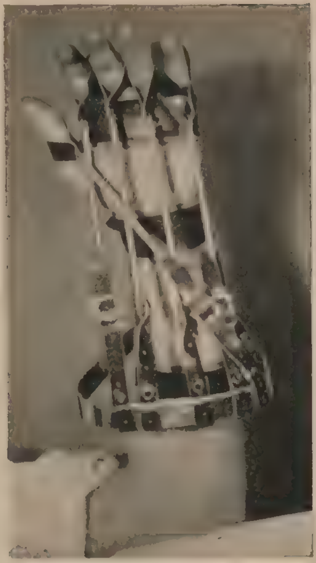

Fig. 318.—Corrective splint for stiff fingers and wrist. (Courtesy of Drs. S. L. Koch and M. L. Mason.)

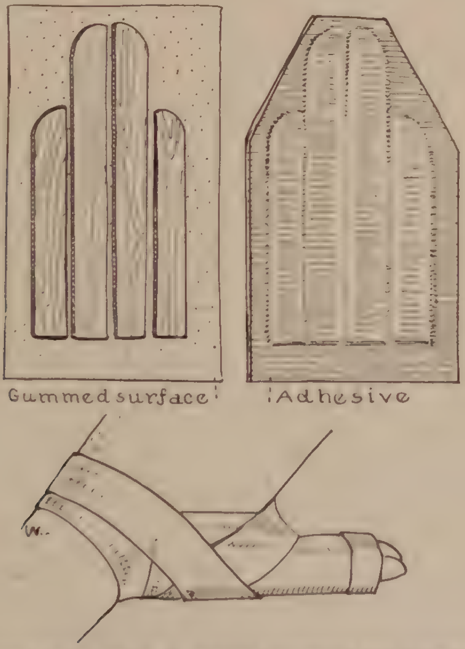

Fig. 319.—Simple thumb splint made of tongue depressors and adhesive. (After Lester, C. W., Jour. Amer. Med. Assoc., July 14, 1928.)

approximated with fine strong suture. As the nail grew, its distal end was pared off and another suture placed near the end of the finger (Fig. 320). This process was continued until a cure was effected in six weeks.

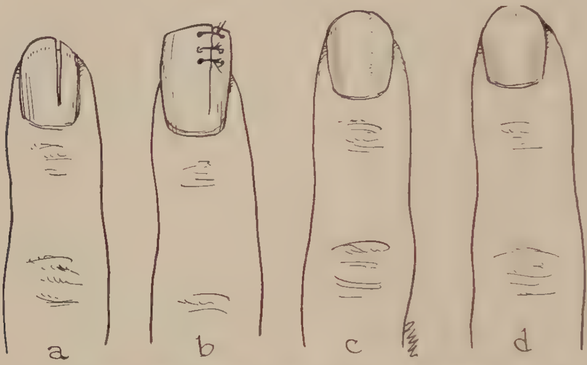

Fig. 320.—Treatment of split finger nails. *a*, Original condition. *b*, Sutures placed through holes in nail. *c*, Nail in process of healing. *d*, Completed cure. (After Carter, W. W., Jour. Amer. Med. Assoc., May 19, 1928.)

(*h*) *Subungual Splinters.*—Wood or metal splinters are frequently embedded beneath the finger-nail. They will generally be visible beneath the nail, but not always so in the case of thick nails. Occasionally dirt left after the withdrawal of the splinter gives the erroneous impression of the splinter still being there. These splinters should always be removed as soon as possible in order to prevent serious infection. Excision of a small V-shaped wedge at the edge of the nail may permit a grasp of the splinter, but more often it will be necessary to cut out a longitudinal slot from the nail. This can be done

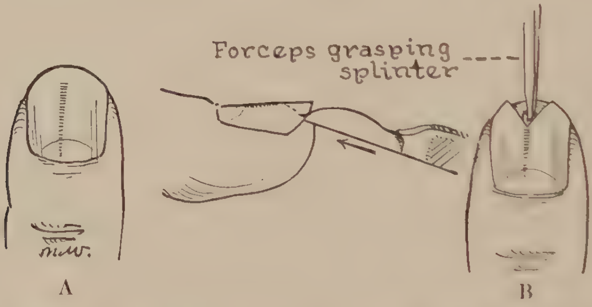

Fig. 321.—Removal of subungual splinter. The splinter may generally, but not always, be seen through the nail (A). A V-shaped piece of the nail tip is excised holding the scalpel pointed upward so that it will not inadvertently injure the nail bed. The splinter is withdrawn with a small mouse-tooth forceps (B).

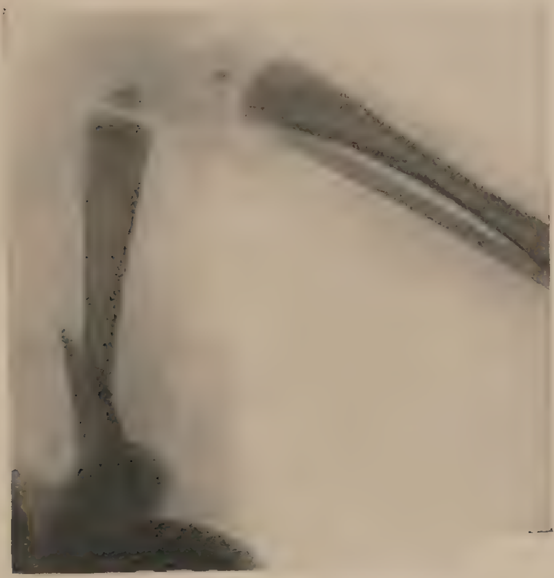

Fig. 322.—Birth fracture of the femur.

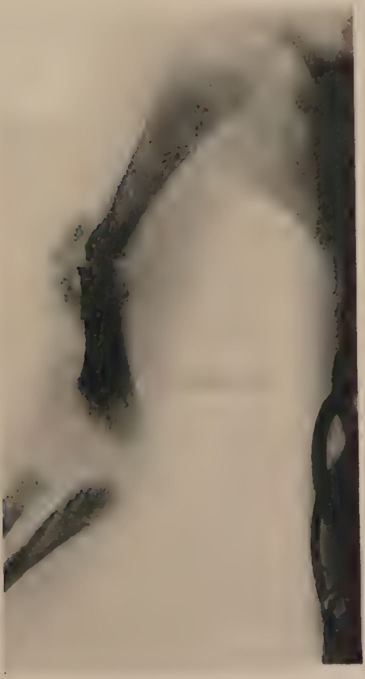

Fig. 323.—Birth fracture of the humerus showing abundant callus formation.

with little or no pain if the finger and nail are firmly grasped in one hand and the nail is carefully cut with a sharp curved scalpel. The scalpel should be so directed that its point does not enter the matrix, and so that if it slips it will go above rather than below the nail (Fig. 321).

(*i*) *Birth Fractures.*—The majority of fractures sustained by an infant during its birth are amenable to simple treatment. *Birth fractures of the clavicle* are evident by the reluctance of the infant to move the corresponding arm, by a tender swelling over the clavicle, and by the *x*-ray examination. The treatment is a posterior figure of-8 bandage or, better, a small-sized DuPuy clavicle brace. It is extremely important to keep the skin under the bandage or brace dry or well powdered. *Birth fractures of the humerus* may be treated by binding the arm to the body by means of a Velpeau bandage, being first careful to place a small cotton pad and an abundance of talcum powder in the axilla. Such a bandage should be carefully changed at least every third day, and the position should be checked by *x*-ray. *Birth fractures*

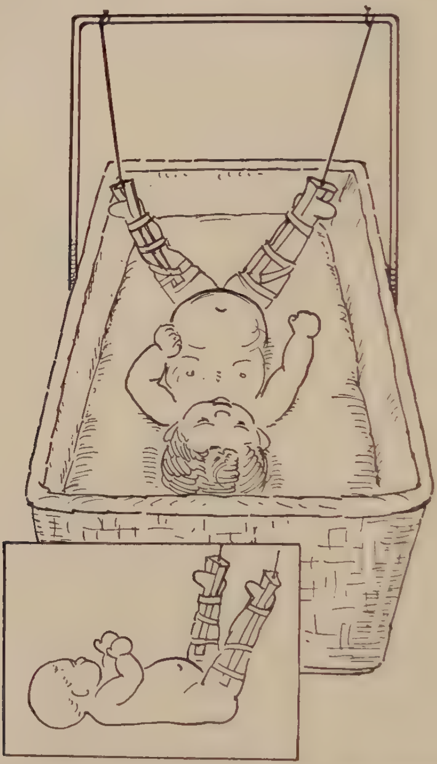

Fig. 324.—Treatment of birth fractures of the femur. The buttocks are just lifted off the bed.

of the femur (Figs. 322, 323) are best treated by overhead traction. Schivers' plaster, moleskin, or adhesive plaster is carefully applied to one or both legs, depending upon the type of fracture and the amount of traction required (Fig. 324). Where a greater amount of traction is required but one extremity is suspended. The extremity or extremities are suspended vertically so that the buttocks are free of the bed. The use of the plaster cast in a newborn babe is extremely dangerous because of the almost certain soiling of the cast with urine and feces, and the consequent danger to the skin. Fractures in the newborn heal with extreme rapidity, and immobilization for two or three weeks will be all that is required in most cases. The formation of callus is abundant. Discrepancies of reduction are quickly overcome by the rapid growth of the bone.

(*j*) *Manipulative Surgery of the Upper Extremity.*—In his very valuable little book Timbrell Fisher[1] has shown the great importance and value of manipulative surgery *in carefully selected cases.* The cases which are benefited fall into four groups (Fisher).

1. Cases with joint adhesions: These may be intra-articular or periarticular, and are associated with acute and chronic synovitis and acute and chronic arthritis. In these cases there is a limitation of motion, pain when an adhesion is stretched, weakness, tenderness generally at the attachment of adhesions.

2. Functional or hysterical cases: In these functional cases there may also be organic trouble.

3. Dislocations or subluxations.

4. Adhesion not related to joints, as in or around muscles, in fasciæ, and connective-tissue layers as the result of injury: The manipulations, which should be done in a quiescent period, require an accurate sense of touch and considerable strength. The best results occur, however, in those cases which require little force. "After the restoration of movement to a stiff joint by manipulation, the joint must either immediately or within a few hours be again moved through the increased range, and this movement must be kept up subsequently at regular intervals to insure success."[2] When movement is decreased by manipulation, the form of treatment or the surgeon's method is at fault. Manipulations are best generally done under nitrous oxide or ethylene anesthesia. Mild cases of joint adhesion may be cured by radiant heat, massage, active and passive exercises. Detailed instructions, abundantly

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[1] Fisher, A. G. Timbrell: Manipulative Surgery, The Macmillan Company, 1926, p. 12.

[2] Fisher, A. G. Timbrell: Ibid., p. 30.

illustrated by photographs, are given by Fisher for each of the joints of the upper extremity. For more detailed instruction the reader is referred to Fisher's book.

19. **Burns of the Upper Extremity.**—These will be treated in accordance with the directions for the treatment of burns given elsewhere.

20. **Frost-bite.**—The fingers are the common site of frost-bite. The relative paucity of circulation in comparison with the large surface exposed to the air make the fingers particularly susceptible to injury by exposure to low temperatures. In these cases there is a preliminary contraction of the vessels with pallor and numbness of the fingers. In milder cases this phase is succeeded by one of redness and swelling, with considerable burning pain. In the trivial cases this condition subsides spontaneously. In cases of severe frost-bite where the skin is still discolored and gangrene has not occurred, the skin should be vigorously rubbed with snow, gauze soaked in cold water, or flannel soaked in alcohol or whisky (DaCosta). Under no circumstances should the hand be placed in warm water, or should the patient suddenly be brought into a warm room. As the finger becomes warm and pink it will be bandaged loosely with cotton. In cases of frank gangrene, amputation will be necessary after the line of demarcation has been established.

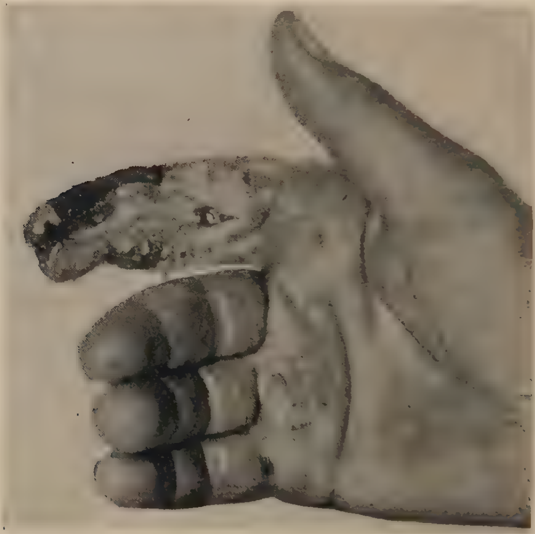

Fig. 325.—Gangrene of finger following aluminum acetate dressing. (Hertzler, A. E., Amer. Jour. of Surg., June, 1927, Paul B. Hoeber, Inc., Publishers, N. Y.)

Where amputation becomes necessary the incision will be made $\frac{1}{4}$ inch above the line of demarcation, and after properly cutting off the bone an effort will be made to arrange the flap so that the suture line is dorsal and the intact skin on the palmar surface.

21. **Chemical Injuries.**—The ill-advised application of dressings moistened with phenol and bichloride of mercury and even of aluminum acetate has caused necrosis of the superficial skin. These chemicals were formerly much used because of their antiseptic properties to the occasional great damage of the parts with which they came in contact. Hertzler[1] reported a case of gangrene of the index-finger following the use of aluminum acetate (30 grains to 1 pint of water). It became necessary to amputate the finger at the metacarpophalangeal joint (Fig. 325). Phenol and bichloride of mercury should *never* be employed in the treatment of infections. Hot boric or magnesium sulphate fomentations should be used instead. Prolonged spraying of the skin with ethyl chloride for anesthesia has caused necrosis and gangrene, and this anesthetic agent should be employed only with great care. In cases of superficial gangrene resulting from these chemicals spontaneous healing will generally occur following the sloughing off of the gangrenous parts. Amputation occasionally will be necessary.

FIRST AID IN MAJOR SURGICAL INJURIES OF THE UPPER EXTREMITY

In cases of traumatic amputation or partial amputation of the upper extremity the hemorrhage may be so profuse as to demand very active first-aid treatment. This will consist of the application of a tourniquet above the bleeding point. Mild antiseptic solution, such as mercurochrome, should be placed in the wound and an abundance of surgical dressings applied. Shock should be combated if necessary and the patient removed as rapidly as possible to the hospital.

[1] Hertzler, A. E.: Amer. Jour. of Surg., June, 1927.

CHAPTER XIX

INFECTIONS OF THE UPPER EXTREMITY

1. **Erysipelas** occasionally occurs upon the upper extremity, but is much less frequent in this situation than upon the face or scalp. It is due to a streptococcic infection which enters through a wound which may be very minute. The characteristic symptoms of elevation of temperature and pulse, sharply demarcated, elevated, red border of the area involved, and the usual treatment by means of various applications, by *x*-ray, and by serotherapy have been described elsewhere.

2. **Chronic Staphylococcus and Streptococcus Infections of the Skin.**—Creeping, serpiginous infections which involve only the outer layers of the epidermis occasionally occur upon the fingers. These infections are characterized by smarting pain and irritation. The finger is slightly swollen, and the superficial layers of the epidermis are lifted up so that thin, watery, non-elevated blisters occur. Hot boric fomentations generally are of little avail in the treatment of this condition. It may be very obstinate and disturbing to both the patient and surgeon. The best treatment is the removal of the necrotic upper layers of the epidermis by means of a very fine forceps and scissors, to remove the purulent secretions beneath, and to dress the affected area with a mild antiseptic ointment. For this purpose a 2 per cent. mercurial ointment is very satisfactory (Oliver, E. A.).

3. **Lymphangitis** is a spreading infection involving the lymphatic vessels. It originates from a superficial wound which may be very small, as a pin scratch, and spreads proximally through the lymph-vessels to the lymph-nodes. It is of rather frequent occurrence upon the upper extremity, and in neglected cases very serious or even fatal results may occur. It is extremely important that the proper diagnosis be made early in this condition, as proper treatment of early lymphangitis is practically always successful and faulty treatment may bring about very bad results. A patient suffering from lymphangitis will generally give a history of having sustained a slight wound of the extremity or he may not even remember having had a wound. The wound may have partially healed and be covered with scab. The hand or forearm is swollen and painful. It is tender to palpation, but *particularly* along the course of the affected lymphatics. The latter may be

recognized by their giving rise to the appearance of red streaks which run up the arm. These red streaks are tender to palpation and may give a slight sense of resistance to the palpating finger. This is particularly true in the deeper, larger lymphatics.

The general condition of the patient shows a prostration, apparently quite out of proportion with the extent of the infection. There will be fever which may reach 103° or 104° F., elevation of pulse, and marked malaise.

The lymphatic channels take the shortest course to the back of the hand and from there are drained through the larger lymph-channels to the axilla. In the words of Koch,[1] "The lymphatic vessels from the little finger and ring finger usually drain into the antecubital and epitrochlear glands, so that these glands may be involved early in infections involving the ulnar side of the hand. The lymphatics of the thumb and index-finger usually drain directly into the axillary glands, so that in infections of the radial side of the hand the axillary glands are the first to be involved. Infections of the middle finger may drain into either the antecubital or axillary glands, but in 15 per cent. of cases, according to Kanavel, drain directly into the supraclavicular glands, so that infection arising in the middle finger may early produce severe systemic symptoms." Lymphangitis is generally classified into superficial and deep varieties. The former is characterized by the red streaks due to the involvement of the superficial lymphatics and the latter by tender, palpable, deep lymphatic vessels. Swelling, pain, and systemic symptoms are common to both. In lymphangitis there is always an enlargement of the cervical lymph-nodes. These, moreover, are tender to palpation.

The treatment of lymphangitis consists primarily in *not* incising. Incision of extremities affected by lymphangitis not only does not remedy the condition, but is liable to cause its spread locally, or bring about systemic involvement. The proper treatment is the application of a copious, continuous hot boric fomentation. The affected arm should be elevated upon a pillow and should be wrapped to a thickness of at least ½ to ¾ inch with sterile gauze for an area well beyond the part involved. This dressing is liberally moistened with a saturated solution of boric acid which is preferably applied warm. The wet dressing is then enclosed in a waterproof material, such as oil silk, rubber sheeting or oil-cloth, and outside of this a hot-water bag or electric pad is placed (Fig. 18). The electric pad may be kept in place by a pinned towel. The moist heat is kept up continuously for twenty-four hours, when the dressing will be changed. At this time the skin will present a wrinkled and dehydrated appearance. The red streaks will be less apparent, and they will be less tender. The skin will then be given a brief respite, say an hour or so, from the hot fomentations, which will then be resumed. This method will be continued until all abnormal appearance and sensation have disappeared. During this time the patient should be at rest in bed, large quantities of fluids should be administered, and free elimination should be secured. Incision should not be carried out unless there is very definite localization with pus formation.

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[1] Koch, Sumner L.: Jour. of the Indiana State Med. Assoc., 21, 137, April 15, 1928.

4. **Cellulitis** is a diffuse involvement of the tissues by pyogenic bacteria. It differs from lymphangitis in not being limited to the lymphatic vessels. It may be a concomitant to deep abscesses to which it is subordinate in importance pathologically. When cellulitis exists alone, it is characterized by a certain amount of brawny induration of the affected area with swelling and tenderness to palpation. The systemic reaction generally is slight. The treatment of this condition is continuous hot boric fomentations. With the employment of this treatment resolution may occur without abscess formation. More commonly, however, the infection will become localized and a discrete abscess will form. When the area of induration has greatly diminished and the abscess seems to have fluctuated and to be well walled off, incision and drainage will accelerate recovery. According to Hoets[1] the very early

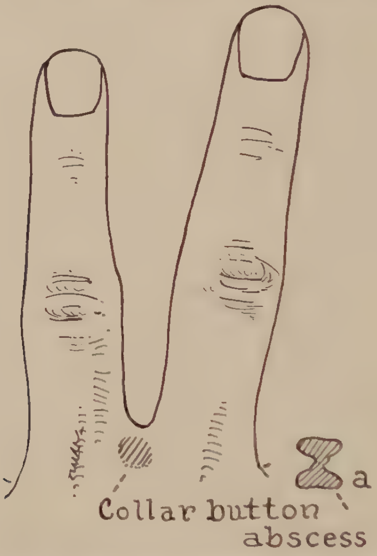

Fig. 326.—Diagram to show collar-button abscess at web of finger. *a*, Diagrammatic cross-section of the abscess.

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[1] Hoets, John: The Medical Journal of Australia, 1, 652, May 26, 1928.

treatment of hand infections by diathermy may prevent pus formation, and after pus has formed, and has been evacuated this method of treatment will help to stop further spread and hasten recovery in a very pronounced degree.

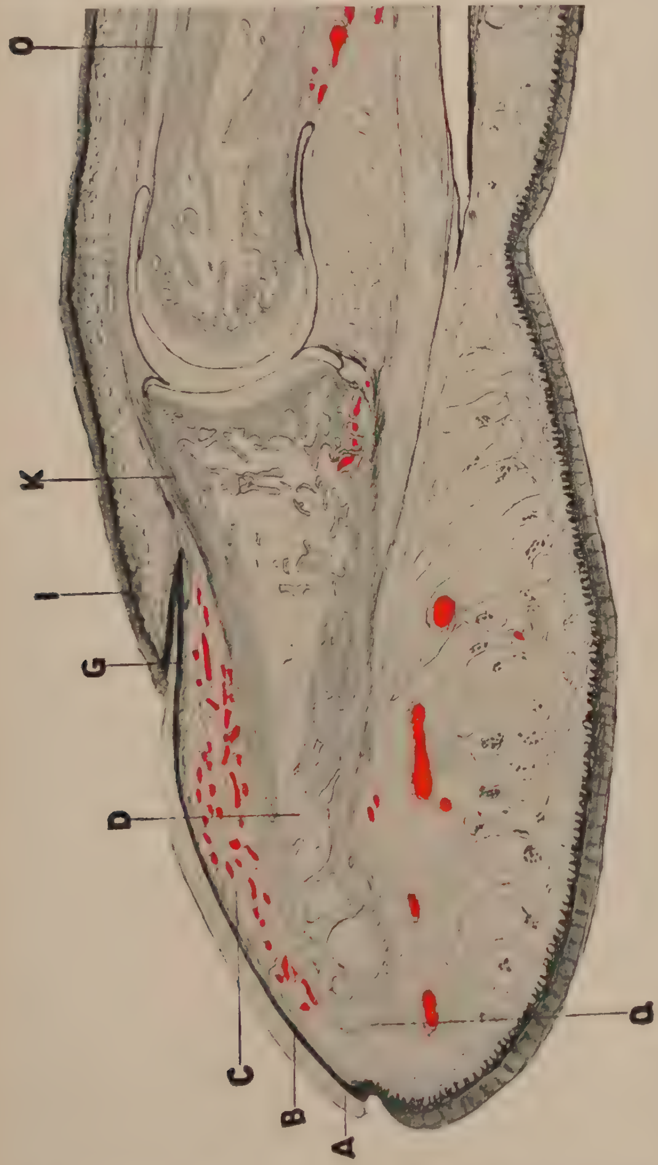

Fig. 327.—Microphotographic drawing of a longitudinal section of a finger end cut anteroposteriorly. *A*, Nail. *B*, Nail-bed epithelium. *C*, Subungual space. *D*, Medullary cavity of diaphysis of distal phalanx. *G*, Nail matrix epithelium. *I*, Eponychial epidermis. *K*, Insertion of extensor tendon. *O*, Dorsal subtendinous space (subaponeurotic space, Kanavel). *Q*, Tip of the distal phalanx where bone, periosteum, subcutaneous tissue, and corium are so intimately fused beneath the epidermis that an infection here readily involves all the dense fibrous tissue, including the bone. (Auchincloss, Hugh, Surgery of the Hand, Vol. III, p. 460, Nelson Loose-leaf Surgery, Thomas Nelson & Sons, New York, 1927.)

5. Furuncle and Localized Abscess.—The diagnosis and treatment of furuncle have been considered elsewhere. Small localized abscesses which do not involve the deeper structures of the hand are not uncom mon. To be mentioned in this regard especially is the so-called *collar-button abscess* (Fig. 326). These abscesses generally occur at the distal edge of the palm, "*web infections,*" and consist of two compartments connected by a narrow communication. A common error of treatment is to incise the superficial and more accessible pocket, and to leave the deeper pocket undrained. The proper incisions are parallel to the long axis of the hand, and extend from the web $\frac{1}{2}$ to $\frac{3}{4}$ inch proximally. It is important to drain both pockets.

6. **Carbuncles** involve the forearm and arm more frequently than they do the hand. Their diagnosis, pathology, and treatment have been considered elsewhere (see chapter on Boils and Carbuncles).

7. **Paronychia ("runaround")** is a pyogenic infection of the tissues in the neighborhood lateral to the finger-nail (Fig. 327). These infections most commonly originate from wounds made by tearing or unskilfully cutting "hangnails" or from trivial abrasions in this locality. The most common site is at the proximal portion of the lateral border of the nail. The pus will accumulate so that a small abscess is formed in this region. If untreated the process may progress around the base of the nail to the other side, when it is termed a "runaround," or it may burrow beneath the nail and involve the nail matrix epithelium (hyponychium). Auchincloss[1] has made a very careful study of finger-tip infections. He defines *eponychia* as a "pus blister" involving the epidermis of the eponychium (the thin layer of overhanging epithelium at the base of the nail—Fig. 328). A *subungual abscess* is an abscess under

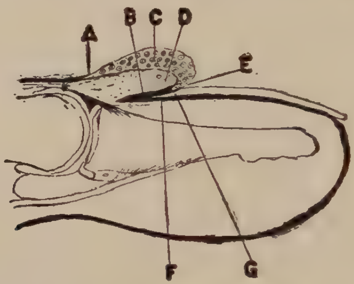

Fig. 328.—Longitudinal section of a finger end to illustrate a "simple" eponychia. *A*, Proximal limits of the "pus blister" in the epidermis of the eponychium. *B*, The "reflected layer" of epithelium from the eponychial epidermis. *C*, Pus in the cavity of the "pus blister." *D*, Inflammatory reaction. *E*, Point where "pus blister" may be opened. Roof-of-blister to be clipped away. *F*, Nail matrix epithelium. *G*, Nail root. (Auchincloss, Hugh, Surgery of the Hand, Vol. III, Nelson Loose-leaf Surgery, Thomas Nelson and Sons, New York, 1927.)

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[1] Auchincloss, Hugh: Nelson Loose-leaf Surgery, Thomas Nelson & Sons, 1927, vol. iii, p. 472.

any part of the nail. A subungual abscess may be continuous with an eponychia or a paronychia (Fig. 329). A subungual abscess may be independent of a paronychia or eponychia. A *paronychia* is an infection or abscess involving the epithelium at the lateral border of the nail. A paronychia may be continuous with a subungual abscess or with an eponychia (Fig. 330). A para-eponychia ("epiparonychia") is a combination of an eponychia and a paronychia (Figs. 331, 332). In the early

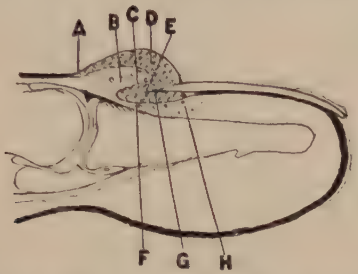

Fig. 329.—Longitudinal section of a finger end illustrating the eponychia associated with a "subungual abscess." *A*, Proximal limit of the "pus blister." *B*, Cellulitis. *C*, "Reflected layer" of epithelium from the eponychial epidermis. *D*, Pus in the cavity of the blister. *E*, Nail root separated from matrix epithelium. *F*, Nail matrix epithelium. *G*, Pus beneath the nail. *H*, Cellulitis. (Auchincloss, Hugh, Surgery of the Hand, Vol. III, Nelson Loose-leaf Surgery, Thomas Nelson & Sons, New York, 1927.)

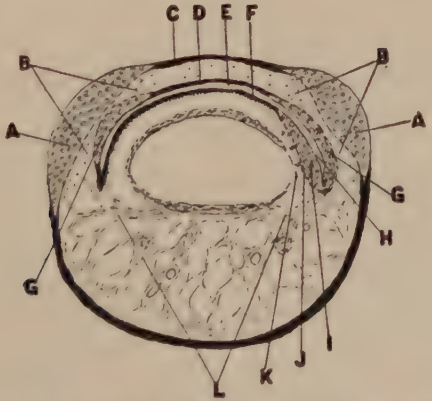

Fig. 330.—Transverse section of a finger end through the matrix, illustrating the pathological anatomy of a "simple" para-eponychia on one side and a para-eponychia with a subungual abscess on the other. *A*, Pus in the cavity of the "pus blister." *B*, Cellulitis. *C*, Eponychial epidermis. *D*, Reflected layer of epithelium of the eponychial epidermis. *E*, Nail root. *F*, Nail matrix epithelium. *G*, Pus between nail root and eponychial epithelium. *H*, Nail root, separated from epithelial attachments and acting as a foreign body. *I*, Pus in subungual abscess. *J*, Matrix epithelium. *K*, Cellulitis. *L*, Fascial septa separating dorsal from anterior aspect of finger. (Auchincloss, Hugh, Surgery of the Hand, Nelson Loose-leaf Surgery, Thomas Nelson & Sons, New York, 1927.)

stages of this affection the inflammation will be diffuse without pus formation. Here the treatment consists of continuous hot boric fomentations, which either will bring about resolution or a definite localized abscess (Fig. 333). A twice daily dressing with equal parts of alcohol and glycerine has been recommended.[1] When an abscess has formed a longitudinal incision should be made laterally to the nail margin and the pus evacuated. The incision should be well to the side of the nail, as injuring the matrix may cause the development of an unsightly nail. If the abscess has burrowed beneath the nail the latter should be elevated by a small hook and the proximal portion of it should be cut away with extreme care not to damage the delicate underlying matrix or the overlying eponychium (Fig. 334). As is aptly said by Auchincloss, "In all these infections, when a subungual abscess has formed, the key to the situation lies in adequate removal of the nail. Failure to do this accounts

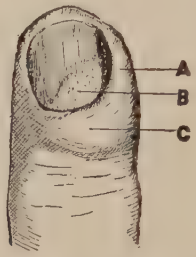

Fig. 331.—Finger end to show the characteristics of a para-eponychia with subungual abscess. *A*, Paronychia. *B*, Subungual abscess. *C*, Eponychia. (Auchincloss, Hugh, Surgery of the Hand, Nelson Loose-leaf Surgery, Thomas Nelson & Sons, New York, 1927.)

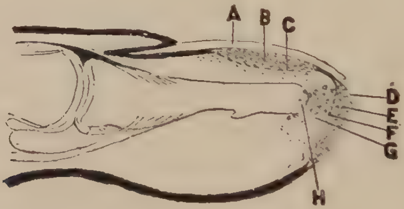

Fig. 332.—Longitudinal section of a finger end to show the pathological anatomy of two types of dorsal infections not associated with eponychia or paronychia. Subungual abscess: *A*, Nail body *B*, Pus. *C*, Nail bed epithelium. Finger tip infection: *D*, "Roof" of "pus blister." *E*, Pus. *F*, Floor of "pus blister." *G*, Cellulitis. Here, where the dense corium merges with the periosteum, is the only place in the finger end where a subungual abscess and a bone infection are likely to be associated. (Auchincloss, Hugh, Surgery of the Hand, Nelson Loose-leaf Surgery, Thomas Nelson & Sons, New York, 1927.)

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[1] Lichtenstein, M. E., Illinois Med. Jour., 55, 125, February, 1929.

for the unnecessary prolongation of most of these infections. The whole nail does not usually have to be removed. Such part, however, as has

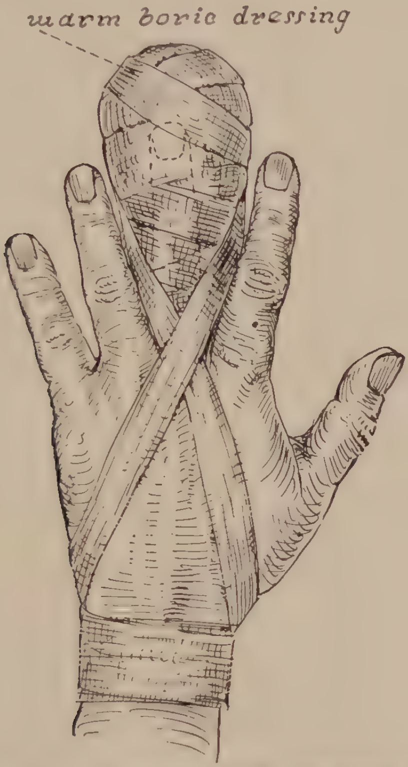

Fig. 333.—Moist boric dressing to finger. Note large amount of gauze necessary.

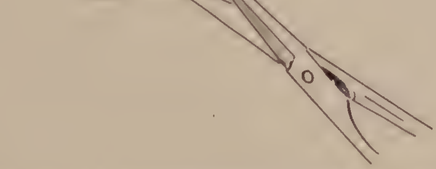

Fig. 334.—Excision of nail root in para-eponychia. Note small hook used to elevate the corner of the nail.

separated from its subjacent epithelium, is like an irritating foreign body in an abscess cavity, and not only should it be removed, but it is wise to err on the radical side in the removal. In fact, when there is an eponychial subungual abscess it is wiser, in most cases, to remove the root of the nail all the way across from one side to the other." At times this procedure will be unnecessary, it being necessary to remove only a small portion of the nail, but this is uncommon, and is fraught with danger of repeated cutting of the nail and of unnecessary prolongation of the case. In the case of simple eponychia without subungual abscess, the treatment will consist of merely cutting away the roof of the pus blister and the application of an ointment or wet dressing. In severe cases of para-eponychia it will be wise to remove the entire nail under general anesthesia. The distal attached portion of the nail is gently freed from the underlying matrix by carefully inserting under it a periosteal elevator or other flat instrument. The nail is then grasped by a strong forceps and removed by a twisting motion (Fig. 335). It is very important to remove *all* of the nail with this procedure. If the nail is torn off so as to leave behind a small piece, the latter will act as a foreign body, and the suppuration will continue. Moreover, it must be

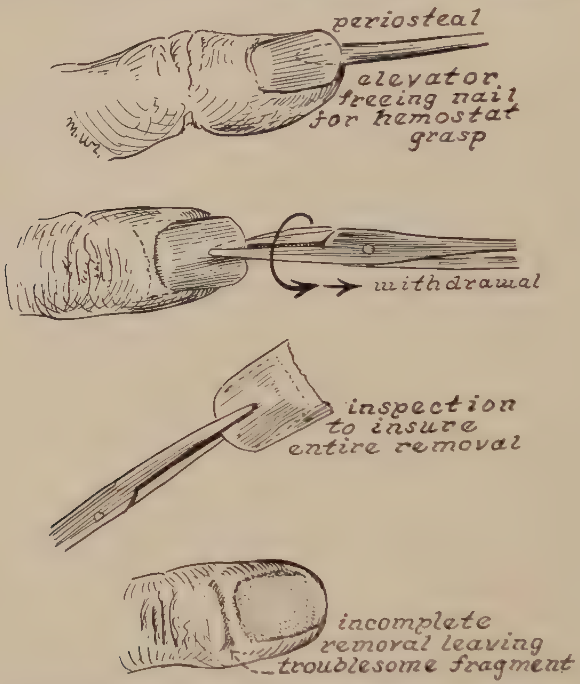

Fig. 335.—Technic of avulsion of nail. Nail separated from bed by periosteal elevator or the flat instrument. Nail seized by hemostat and removed by twist and traction. Nail inspected to be sure that it is all removed. Incomplete removal of the nail leaves a troublesome fragment under the eponychium, and suppuration continues.

emphasized that rough efforts to search for such a fragrant or to curet under the delicate eponychium may cause permanent damage to the matrix. If the removed nail appears to be incomplete, the eponychium should gently be lifted up with a small hook and the offending piece be removed under direct vision with a very small tissue forceps. "A little packing may be placed under the eponychium to hold it away from the nail-bed for twenty-four or forty-eight hours and thus favor drainage" (Koch.) This measure, however, is but infrequently needed. Le Seur[1] advises never to incise the matrix of the nail longitudinally because it leaves a split nail.

8. **Felon or Whitlow.**—The term "felon" has been applied to a variety of infections involving the distal portion of the finger. The connective tissue of the distal phalanx forms a closed sac which includes the diaphysis of the bone. Fibrous septa run vertically from the palmar surface of the skin, and divide this sac into several chambers. Infection which develops in these spaces tends to remain there because of the thickness of the palmar skin, or else very early to attack the bone itself. The term includes those infections which are centered in or beneath the periosteum of the distal phalanx, abscess formation of the pulp of the finger pad above the periosteum, and collar-button abscesses of the finger-tip. It is extremely important to make an early diagnosis. This may present considerable difficulty. There may or may not be an external wound. It is possible that some slight blow upon the finger-tip may bring about a *locus minoris resistentiæ* where organisms brought by the blood-stream from a distant focus will settle and propagate. A very trivial wound, as a pin prick or a thorn prick, may be the cause of a felon. The characteristic symptoms of a felon are: first, extreme pain; second, swelling; third, throbbing pulsation; and fourth, tenderness of the phalanx itself. The patient will report that he gradually has been having an increase of pain in his finger-tip which has become so severe as *to interfere with his sleep.* The affected finger-tip will be somewhat red, will be swollen, and will be extremely sensitive to palpation. A careful painstaking examination generally will elicit the fact that continued palpation of the tip of the distal phalanx is extremely painful, although the maximum redness and inflammation will seem to be at a point somewhat removed from there. This tenderness of the bone itself is suggestive of an early osteomyelitis or periostitis. It may further be elicited by a squeezing pressure of the base of the distal phalanx.

Once the diagnosis of felon has been established, prompt surgical treatment is indicated. Hot fomentations or inadequate small "medical incisions" will only cause increased pain, and will do actual harm. Radical free incisions should be made. For this purpose a common incision is a transverse one made directly across the finger-tip, and deepened through the finger pad until the surface of the periosteum of the distal phalanx is reached. During the making of this incision it is not uncommon to open a discrete abscess. Should this be the case, no further procedure is necessary other than the insertion of a vaseline-gauze drain. Should pus not be encountered, however, the periosteum should be nicked with the scalpel and the margins of the incision held apart by a vaseline-gauze drain (Fig. 336). Koch[1] says "the horseshoe-shaped incision over the end of the finger should be avoided because it is unnecessarily large, is slow in healing, and leaves a tender scar over the sensitive tip of the finger." This surgeon believes that adequate drainage may be secured by an incision on one side of the affected phalanx provided that the incision is sufficiently large and divides the vertical fibrous septa. The tendon sheath at the base of the distal phalanx should be avoided. Auchincloss advises the hockey-stick incision (Fig. 337). Incisions on the palmar surface of the finger are ill advised because of their inadequacy for drainage, and because of the likelihood of subsequent tender scar formation (Fig. 338). The finger is now enclosed in a copious boric dressing. The gauze drain is not removed at the first or second dressing, but is allowed to remain until it either comes out by itself or can be withdrawn without much pain. It is not uncommon in cases of felon to have necrosis of the distal phalanx (Fig. 339). Small fragments of bone

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[1] Le Seur, H. H.: Amer. Jour. of Surg., January, 1927.

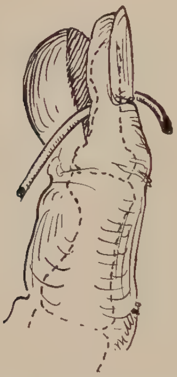

Fig. 336.—Finger-tip splitting incision with rubber drain in treatment of felons. The "hockey-stick" incision is preferable.

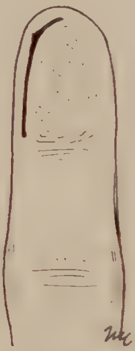

Fig. 337.—"Hockey-stick" incision in the treatment of felons.

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[1] Koch, S. L.: Jour. of the Indiana State Med. Assoc., 21, 137, April, 1928.

may spontaneously extrude themselves from the wound. In neglected cases the entire diaphysis may be involved with a resultant shortening of the finger. Even with early diagnosis and prompt treatment it may be impossible to prevent the loss of a small fragment of a necrotic bone and the patient should be acquainted with this danger at the outset of the treatment (Figs. 340, 341).

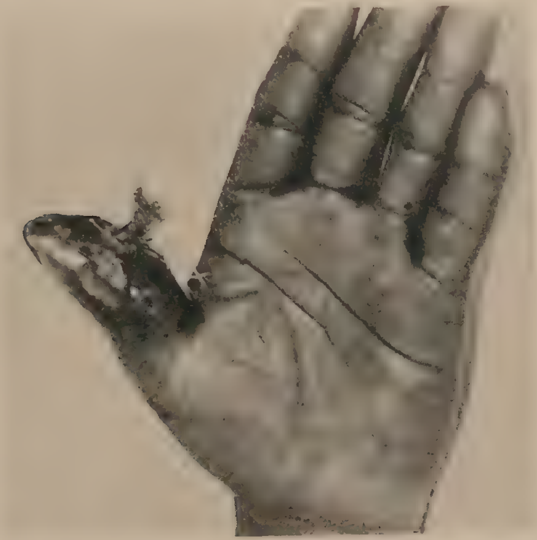

Fig. 338.—Improper through-and-through drainage in infection of a thumb.

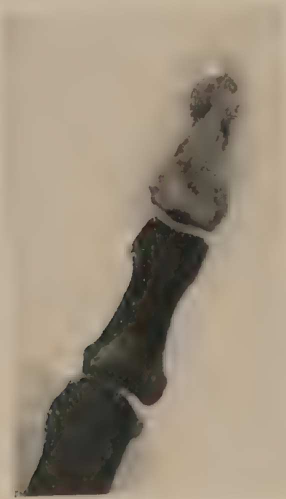

Fig. 339.—Destructive osteomyelitis of the distal phalanx in a case of neglected felon. (Surgical Dispensary, Northwestern University Medical School.)

9. Suppurative Tenosynovitis.—The modern conception of the pathological anatomy and treatment of hand infections is practically all based upon the pioneer work of Kanavel, and to him must be accorded credit for our better understanding of this subject. The tendon sheaths may become infected through the introduction of organisms, generally the staphylococcus, by wounds, and less frequently by direct extension of the infection from neighboring parts. Wounds which cause the introduction of pathogenic organisms into the tendon sheath are generally of the puncture or stab variety. Wounds caused by can openers, nails, and sharp-pointed knives are particularly culpable. Tendon sheath infections are extremely serious because of the rapidity of their

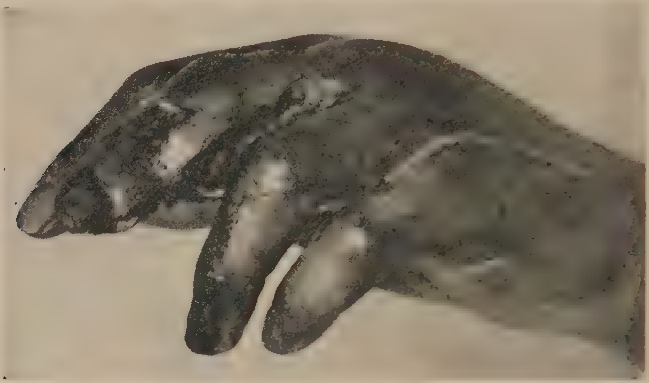

Fig. 340.—Infection of finger following bite. Note lateral incision for sheath infection.

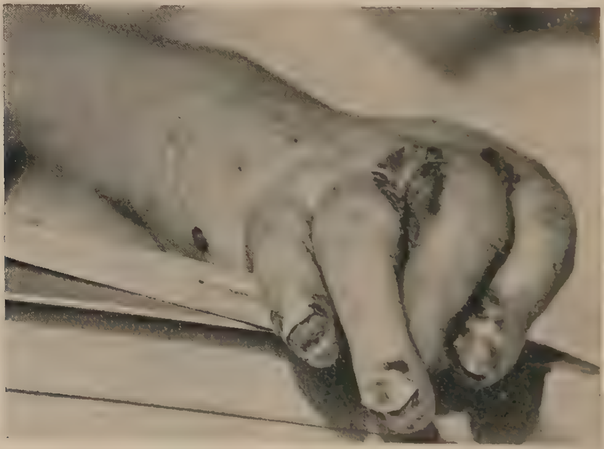

Fig. 341.—Psoriasis of nails with arthritis deformans. Successfully treated by x-ray and ammoniated mercury ointment. (Courtesy of Dr. Edward A. Oliver.)

spread, and because of likelihood of causing destruction of the tendon sheath or of the tendon itself. A few hours after the infection of the sheath the patient will experience pain and tenderness of the part involved. After twenty-four hours or more the disturbance will be very marked and it is imperative to make an early diagnosis.

The three cardinal symptoms of tenosynovitis, according to Kanavel, are as follows: (*a*) Exquisite tenderness over the course of the sheath and limited to the sheath; (*b*) flexion of the fingers; (*c*) exquisite pain on extending the finger, this pain being most marked at the proximal end of the finger. If the tendon sheath be not widely opened and drained, the pus which forms under pressure, and which is limited to the rigid envelope of the sheath will spread along its extent and will invade various other structures according to what sheath is involved. The tendon sheaths of the index-, middle-, and ring-fingers extend from just beyond the distal flexion crease of the finger to a line which closely approximates the distal palmar flexion crease. The sheath of the long flexor of the thumb begins at a point slightly distal to the distal flexion crease of the thumb, and accompanies the flexor pollicis longus through the palm to terminate a thumb's breadth above the anterior annular ligament in an expansion known as the radial bursa (Fig. 342—Koch).

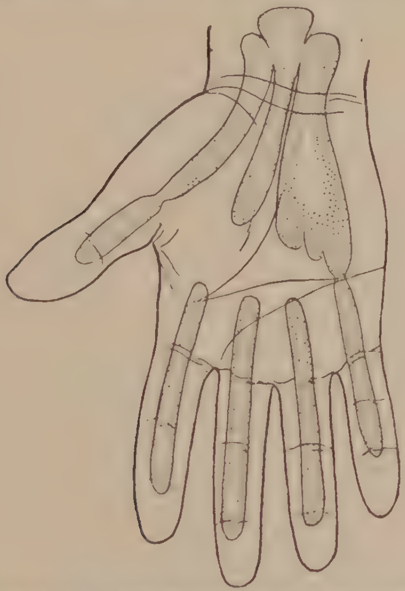

Fig. 342.—The relation of the flexor tendon sheaths and the radial and ulnar bursæ to the superficial markings of the hand. (Koch, S. L., Jour. of the Indiana State Med. Assoc., 21, 137, April, 1928.)

The tendon sheath of the flexors of the little finger begins just distal to the distal flexion crease of the fifth finger and extends proximally to become continuous, in the majority of cases, with the ulnar bursa, a good-sized sac which lies over the metacarpal bone of the ring-finger and the head of the middle metacarpal bone, and extends proximalward under the anterior annular ligament a thumb's breadth above the ligament (Koch—Fig. 342). The possible extension of infections of the various tendon sheaths is indicated in Table A, made from the studies of Kanavel. Kanavel injected the tendon sheaths with a visible injection mass under varying degrees of pressure and traced the extensions of this injected mass.

TABLE A

Possible Extensions of Infections from Various Sites in the Hand (After Kanavel)

Site of original infection.	Possible extensions.
1. Thumb	In the majority of cases the pus ruptures from the sheath of the flexor longus pollicis into the forearm. Rarely invades the thenar space. May involve dorsal subcutaneous tissue. By synovial sheath extension to thenar space.
2. Index-finger	Subcutaneous tissues of dorsum of hand. Rarely middle palmar or thenar spaces (fascial-space extension). By synovial-sheath extension to the thenar space.
3. Middle finger	Synovial-sheath extension to the middle palmar space, exceptionally, the thenar space.
4. Ring finger	Synovial-sheath extension to middle palmar space.
5. Little finger	By tendon-sheath extension to middle palmar space, or if continuous with ulnar bursa to the forearm.

The common error in the treatment of tendon-sheath infections is the withholding of adequate incision until the pus has burrowed to some distant extension of the sheath or has burst through the sheath and caused a considerable amount of damage. It is extremely important in all cases of infection of the hand not to be content with hot fomentations unless a vigorous effort has been made to exclude the presence of tenosynovitis. The treatment of tenosynovitis is the wide opening of the tendon sheaths along all the part of it which is infected by the infections. It is far better to open a few tendon sheaths too early than one too late (Auchincloss). "Decisive hesitation is far wiser than hesitating decision" (Sir. W. R. Gowers, quoted by Auchincloss) in case of doubt. The incisions for opening these sheaths are indicated in Figure 343. In general, it may be said that incisions in the finger should be at the lateral margin and should be limited to the individual phalanges, that is, they should not cross the flexor creases of the volar surface of the fingers. It is generally advisable to have incisions on both sides of the fingers, which enter the tendon sheath and permit cross drainage. The incisions are best made under general anesthesia and in a field which has been rendered *bloodless by means of a blood-pressure machine tourniquet.* The incisions for the radial and ulnar bursæ will follow the general course of these structures. Where the pus has escaped from a radial or ulnar bursa and has passed beneath the annular ligament of the wrist into the forearm, the maximum accumulation of pus will be beneath the flexor tendons and at an area 2 or 3 inches above the wrist-joint. Lateral incisions into the forearm should be made on both sides in this area. Once the incision has been made, the margins of the wound should be held open by light gauze packing, rubber tissue drain, or, perhaps best of all, a small piece of split rubber tubing may be sutured with plain catgut into the depths of the wound. Koch says that "the use of through-and-through drainage above or underneath a flexor tendon should be carefully avoided. It is the surest possible method of causing necrosis of the tendons." The institution of hot boric fomentations (see Fig. 18) or hypertonic magnesium sulphate dressings will facilitate drainage from the wound. The extremity is placed at rest either on a pillow or splint or in a sling. The dressings are done under strict aseptic precautions to avoid mixed infection. As the purulent discharge diminishes, early active motion of the fingers and hand is cautiously instituted. The prognosis in cases which are subjected to early surgery is excellent. In cases where failure has been made to make a proper diagnosis or in which surgery has been delayed, very serious results may occur. A far wider area of the involvement is to be expected, the pus may spread

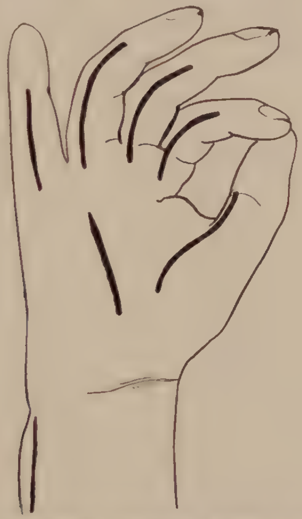

Fig. 343.—Lines of incision for drainage of tendon sheaths. (After Koch.)

outside of the tendon sheath to the fascial spaces, or it may even involve the bones and cause an osteomyelitis. The loss of a finger or even of a hand is not uncommon. Even if this unfortunate eventuality be avoided, the sloughing and loss of portions of tendons may occur with resultant loss of function of the finger. Should ankylosis of a finger become inevitable, the position of half flexion is the optimum for use and comfort. Ankylosis in extension produces a practically valueless finger.

10. **Fascial Space Infection.**—The hand contains five principal fascial spaces which are subjected to infection by punctured wounds or by direct extension from tendon sheaths, bursæ, or adjacent soft parts. The *middle palmar space* may become infected by extension from the middle, ring, and little fingers, the ulnar bursa, the lumbrical canals, or by osteomyelitis of the middle and ring metacarpals, or by direct implantation. In this condition there is a marked swelling of the palm of the hand, so as to cause a loss of concavity. There is extreme tenderness in the palm of the hand. There will be marked swelling of the dorsum of the hand. If this condition be neglected, there is likely to be a spread of the infection to the forearm. The treatment is adequate surgical incision and drainage. The line of incision best suited to this operation is indicated in Figure 344. Through-and-through drainage to the dorsum of the hand should never be carried out.

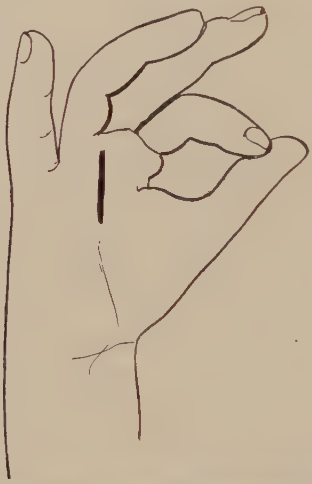

Fig. 344.—Line of incision for drainage of midpalmar space. (After Koch.)

The *thenar space* which lies upon the adductor muscle of the thumb and is partially covered by the short muscles of the thenar eminence, by the flexor tendons of the index-finger and by the accompanying digital vessels and nerves (Koch) may be infected by extension of the infection from the index-finger and thumb, by direct implantation or by osteomyelitis of the index and thumb metacarpal (Fig. 345). Infection of the thenar space is likely to spread to the forearm. The treatment is proper incision and drainage (Figs. 346, 347).

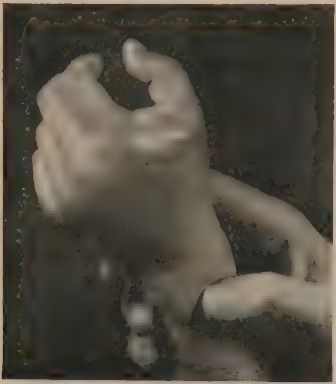

Fig. 345.—Thenar space abscess. (Surgical Dispensary, Northwestern University Medical School. Drs. John A. Wolfer and M. L. Mason.)

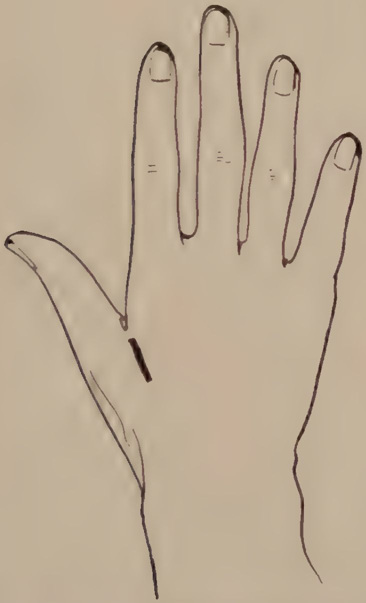

Fig. 346.—Line of incision for drainage of thenar space.

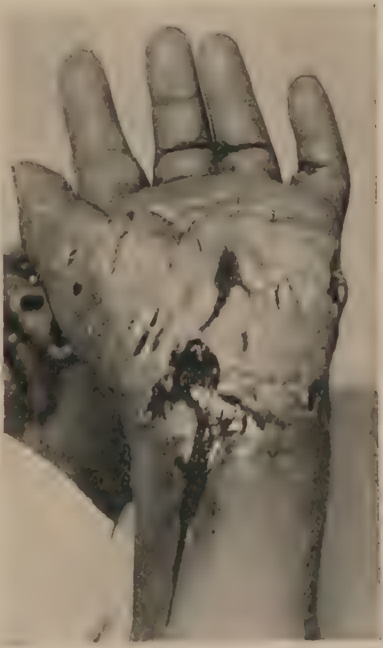

Fig. 347.—Hand infection with involvement of thenar space in a diabetic.

The *hypothenar space* is generally well localized and infection of it is quite unlikely to spread either to the forearm or to the adjacent structures. The treatment is incision and drainage.

The *dorsal subcutaneous space* and the *dorsal subaponeurotic space* are well localized and are not particularly susceptible to extension of infection. In the case of the former the incision necessary for drainage does not have to be as deep as for the latter. The possible extensions of infections from fascial spaces, according to Kanavel, are the following:

(*a*) Palmar space: Under annular ligament of the wrist to the forearm.

(*b*) Thenar space: To dorsum of the hand, rarely if ever to the forearm.

(*c*) Hypothenar space: Does not communicate with any large space.

(*d*) Forearm: Largest part of the space is 2 inches above the wrist. Infection of fascial spaces without involvement of tendon sheaths generally heal kindly with ordinary incision and drainage. Where the tendon sheaths also are involved, these must be treated according to the principles laid down above. The wounds made in the treatment of hand infections are lightly packed with gauze impregnated with petrolatum. Copious hot boric fomentations are added (see Technic of Hot Wet Dressings, p. 58).

11. **Epitrochlear Lymphadenitis.**—As indicated previously, the epitrochlear glands become enlarged following lymphangitis and other infections involving the little and ring fingers. Occasionally these lymph-nodes will become large, red, tender, and fluctuation eventually will become apparent. When the lymph-nodes break down in this manner incision and drainage are indicated.

For specific infections involving the hands see Chapter II on Open Wounds. (See Tuberculosis Verrucosa Cutis.)

12. **Tuberculous Synovitis.**—In one type of chronic tuberculous tenosynovitis the tendon sheath is lined by edematous granulation tissue and is only slightly tender. This type may suppurate, in which case it is treated by tapping.[1] In the other type there is passive effusion into the synovial space with some thickening of the lining membrane. In all cases of tuberculous tenosynovitis the patient is given prompt and energetic treatment of his systemic tuberculosis (fresh air, food, rest, etc.).

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[1] Rose and Carless: Manual of Surgery, 12th ed., William Wood & Co., 1927, p. 459.

13. **Tuberculosis of Joints.**—Tuberculosis rarely involves the joints of the upper extremity. The elbow is most commonly involved. It is characterized by swelling, pain, limitation of motion, and by the characteristic *x*-ray findings (Fig. 348). There may be muscular atrophy. The body temperature is elevated and there is history of chronicity. Evidence of tuberculosis elsewhere in the body generally will be found. Systemic treatment of the tuberculosis is first indicated. According to Allison[1] early excision gives the best results in adults. In children "careful protection of the diseased elbow for a long period of time is the only treatment for the local disease" (Allison). For this purpose the Robert Jones necklace and wrist sling is very useful (Fig. 349). Tuberculosis of the wrist-joint is characterized by swelling, heat, and stiffness. The treatment is directed toward the general condition, and also immobilization of the wrist on molded plaster splints. Excision of the joint is performed in severe cases.

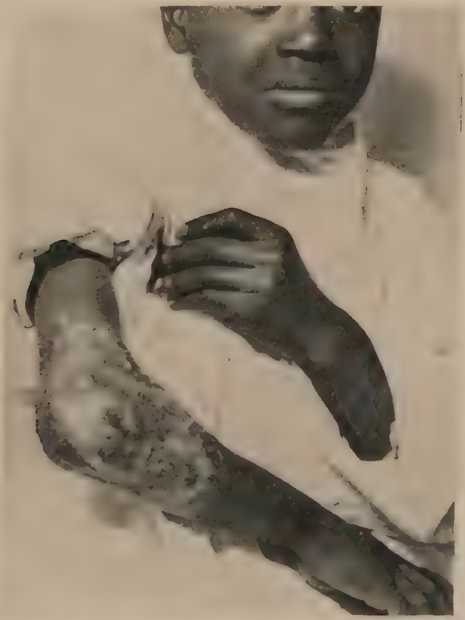

Fig. 348.—Tuberculosis of the elbow with tuberculosis of the skin. (Courtesy of Dr. Edward A. Oliver.)

14. **Tuberculosis of the Phalanges (Spina Ventosa), Tuberculous Dactylitis.**—In this condition there is a swelling of one of the phalanges due to tuberculosis of the shaft (Fig. 350). The child holds the finger

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[1] Allison, Nathaniel: Nelson Loose-leaf Surgery, Thomas Nelson & Sons, 1927, vol. iii, p. 66.

stiff, but it is not particularly painful. There is necrosis of bone with sequestrum and involucrum formation. The x-ray examination is important. Rest of the finger and measures directed toward improving

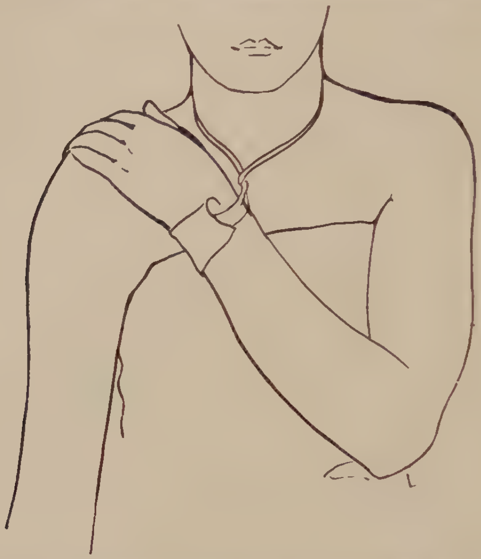

Fig. 349.—The Robert Jones necklace and wrist sling for the treatment of tuberculous elbow. (Allison, Nathaniel, Orthopedic Surgery, Vol. III, Nelson Loose-leaf Surgery, Thomas Nelson & Sons, New York, 1927.)

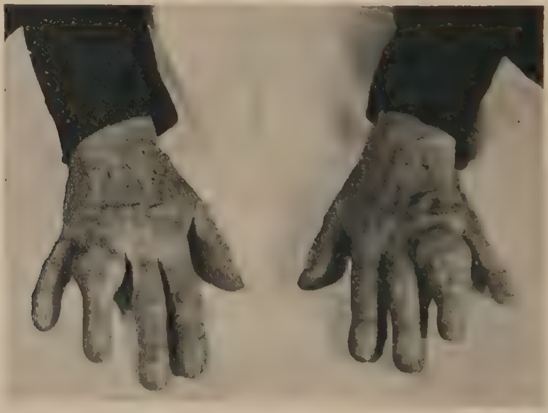

Fig. 350.—Tuberculosis of the fingers (spina ventosa). (Surgical Dispensary, Northwestern University Medical School. Courtesy of Dr. M. L. Mason.)

the general health may cure the early cases. In the later cases the dead bone should be removed by operation. After operation the finger is put at rest in a splint.

15. **Acute osteomyelitis** is of relatively infrequent occurrence in the bones of the upper extremity; the distribution of 385 separate osteomyelitis lesions was reported by Klemm[1] as follows:

Femur	111
Tibia	101
Humerus	27
Os ilii	26
Fibula	23
Calcaneus	19
Skull	11
Radius	8
Ulna	8
Metatarsals	8
Talus	8
Clavicle	7
Sacrum	6
Vertebræ	4
Sternum	3
Ribs	3
Scapula	3
Os pubis	2
Os ischii	2
Phalanx man	2
Os cuboideum	1
Phalanx ped	1
Metacarpus	1

The infecting microörganisms may reach the bone by the blood-stream, by direct extension from the soft parts, or by open wounds of the bones. The hematogenous origin is the most frequent. "The main cause of osteomyelitis is the Staphylococcus and its chief habitat is the skin. Bacteria enter the blood-stream from the skin focus, and lodge in the bones" (Phemister). Boils and all other types of cutaneous pyogenic infections are important etiologically.

In the young the infection generally begins in the metaphysis very rarely in the epiphysis. In adults the infection may begin in any part of the bone. The infection rapidly extends along the medullary canal or through the cortex to the periosteum. The pus may spread along beneath the periosteum and infect the cortex and medullary cavity at some more distant point. Extensive necrosis of bone may result.

Robertson[2] believes that trauma plays an important etiological rôle, but doubt is cast upon this statement by the fact pointed out by Phemister that so few fracture cases acquire a hematogenous infection.

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[1] Klemm, P.: Acute and Chronic Infectious Osteomyelitis in Childhood, S. Karger, Berlin, 1914, quoted by Phemister, D. B., Nelson Loose-leaf Surgery, Thomas Nelson & Sons, 1927, vol. iii, p. 699.

[2] Robertson, D. E.: Jour. Bone and Joint Surg., 9, 8, January, 1927.

The diagnosis is made by rapid onset of pain, exquisite tenderness over the affected area of bone, and by fever, chill, and general prostration. In the early cases there may be but slight amount of swelling of the overlying soft parts, but these are commonly red and inflamed. Leukocytosis (20,000 to 40,000) is the rule, but the writer has seen a case of osteomyelitis with a normal white blood-count. There may be a positive blood-culture. The *x*-ray is of no value before the fifth to tenth day in the making of the diagnosis of a case of osteomyelitis. The treatment of acute osteomyelitis is a well-recognized surgical emergency. The importance of early surgical intervention is probably more marked in this case than in a case of acute appendicitis. Failure to provide early drainage in acute osteomyelitis hourly increases the risk of dissemination of the infection throughout the bone or beneath the periosteum with the possible consequent loss of large portions of bone. Under general anesthesia a free longitudinal incision is made over the site of maximum tenderness. Starr[1] says that care should be exercised to keep the incision clearly on the diaphyseal side of the epiphysis and to preserve the attachment of this membrane to the epiphyseal line, a precaution which may prevent the extension of infective material into the adjacent joint. The soft parts are divulsed with the minimum amount of damage until the periosteum is exposed. During this procedure an abscess may be broken into, but this should not deter the operator from continuing until the periosteum is exposed. After the wound has been well sponged and properly retracted, incision should be made into the periosteum itself. Pus may now escape, indicating that the principal involvement is subperiosteal. The incision should extend for the entire length of the separated periosteum (Phemister). The surgeon, however, is not justified in concluding that this is the only involvement, but should make several drill holes through the cortex of bone at this region. Small $\frac{1}{8}$-inch drills suffice for this purpose. If pus be not encountered after incision of the periosteum, three or four drill holes will be made through the cortex of bone. After the drill hole has been made and the drill removed, after a short interval of time, a small quantity of pus may frequently be seen to ooze up through the freshly made drill hole. From this point on opinion is divided as to the best surgical practice. Starr and others are content to depend upon the drill holes alone. Phemister and others (including more recently Starr), however, believe that greater safety will be obtained without practically increasing the damage to the bone by removal of a small window of the cortex in the involved portion by means of a chisel and hammer. Extensive opening is harmful. John B. Murphy is credited with having said that in the case of a patient far removed from operating room or surgeon the best treatment rather than delay is to drive a nail through the cortex of the bone. Vaseline gauze should be placed over the wound edges, and need not be removed except at every third or fourth dressing. A vaseline gauze drain is placed down to the bone wound, and is removed on the second or third day. Hot boric fomentations generally add to the comfort of the patient. Of interest are the observations of Krasnobaew[1] based upon a study of 428 cases of acute osteomyelitis. This author concludes that it is particularly important to note the patient's general condition, and to do everything possible to conserve his strength and spare his tissues. In the first stage of serious acute osteomyelitis operations which necessitate general anesthesia should be avoided. Too active treatment in the first stage is not only useless, but dangerous. In the first septic stage all that can be done is opening of the abscess as soon as possible by incisions extending down to the bone. Wicks and tampons should not be used. Drains should be employed rarely and for only a very short time. Buzello[2] believes that in acute osteomyelitis the infected marrow cavity should be chiselled open as soon as possible even in the presence of an abscess in the soft parts. This author calls attention to the importance of using a sharp chisel, and separating the periosteum as little as possible. The edges of the bone are covered with invaginated skin. He believes moist compresses to be contraindicated. Dressings in osteomyelitis cases are extremely painful and need not be frequent. One should beware the danger of leaving small gauze sponges in the depths of the wound. Orr[3] packs the wound with vaseline gauze and dresses it three times in six weeks.

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[1] Starr, C. L., Lewis' Practice of Surgery, W. F. Prior Co., Inc., vol. ii, 1927, p. 23, chap. 2.

In the hand osteomyelitis occurs very frequently as the result of infection which has involved the soft parts. The partial traumatic amputation of fingers is a frequent cause of osteomyelitis of the temporarily exposed bone. Osteomyelitis of the distal phalanx occurs with felon. Osteomyelitis of the metacarpals occurs in fascial space and tendon sheath infection. In these cases there is generally an adequate external wound for drainage. Should this not be the case, one should be made. With proper drainage instituted the expectant course is justified. Where the involvement of the bone is small, minute fragments of necrotic bone may spontaneously be extruded from the wound.

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[1] Krasnobaew, T.: Chir. d. organi di movimento, 1926, 10, 537.

[2] Buzello: Zentralbl. f. Chir., 1928, 55, 820.

[3] Orr, H. W.: Journal-Lancet, 45, 515, November 1, 1925.

Where the drainage has persisted for a long time, the existence of an osteomyelitis must be suspected and an x-ray examination should be made. When the latter reveals a discrete sequestrum, it may be removed by surgical incision. It is inadvisable to remove by curet or ronguer dead bone which has not yet become completely separated from the adjacent live bone. It is surprising how well the body takes care of the process of scavenging dead bone. After many weeks of drainage it is not uncommon to see a very large sequestrum present at the orifice of the wound, which readily may be removed by slightly enlarging the latter. Moreover, premature or rough attempts to remove a sequestrum invite the danger of a systemic infection.

16. **Chronic Osteomyelitis.**—The treatment of chronic osteomyelitis belongs to the realm of major surgery.

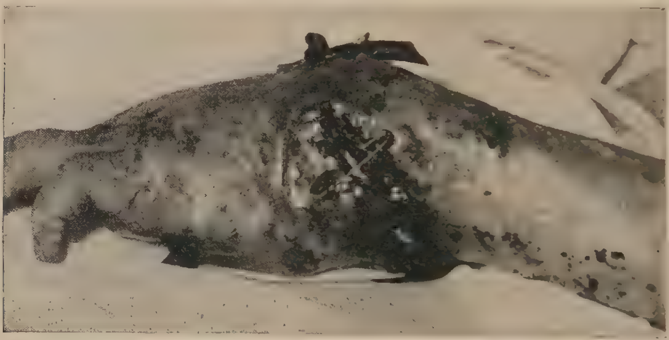

Fig. 351.—Suppurative arthritis of the wrist-joint. Improper through-and-through drainage with rubber tubes.

17. **Suppurative Arthritis.**—Puncture wounds involving the joints of the fingers, wrists, or elbows very commonly will heal spontaneously. In other cases the increase of pain, swelling, and temperature will indicate the onset of a suppurative arthritis. The treatment of choice will be the aspiration of the joint cavity, and lavage with saline or $\frac{1}{2}$ per cent. mercurochrome solution. Repeated aspirations of this type may bring about a cure. Whereas it is preferable to keep the joint closed, in some cases it will be necessary to open the joint and institute drainage. For this purpose lateral incisions are preferable, and the patient is advised to begin early active motion of the affected joints. This motion will bring about better drainage of the joint and will diminish the likelihood of joint adhesions and ankylosis (Wilms). In the very severe cases of suppurative arthritis of the upper extremity resection of the joint and even amputation may be required, certainly not a procedure of minor surgery (Fig. 351).

CHAPTER XX

TUMORS AND DEFORMITIES OF THE UPPER EXTREMITY

1. **Benign Tumors.**—(*a*) *Ganglion* ("*Weeping Sinew*").—The recent studies of Carp and Stout have done much to clarify our knowledge of ganglion. These authors define ganglion as a "cystic swelling usually occurring in close proximity to joints and tendon sheaths, and containing a thick mucinous fluid." They are most commonly found in the regions of the wrist (Fig. 352), ankle, knee, and the volar regions of the fingers and hand. Numerus theories have been advanced to explain their origin, but no definite conclusion regarding their genesis has as yet been reached. The popular idea that they are hernial protrusions has not been substantiated. Carp and Stout[1] believe that ganglia are "cysts resulting from mucinous degeneration of connective tissue" which do not communicate primarily with joints or sheath spaces. Certain authorities contend that they do communicate with tendon sheaths. They are most commonly found in females of slight build in the second, third, and fourth decades. Trauma probably has little relationship etiologically. The ganglia range in size from very small pea-sized nodules up to 2 or 3 cm. in diameter. They may be multilocular, and in the larger ones fluctuation may be elicited. When present on the dorsum of the wrist they may be made to appear more prominent by acutely flexing the hand. The conditions from which a differential diagnosis must be made include tuberculosis of the joint and tendon sheath, lipoma, myxoma, fibroma, osteoma, sarcoma, bursitis, and aneurysm.

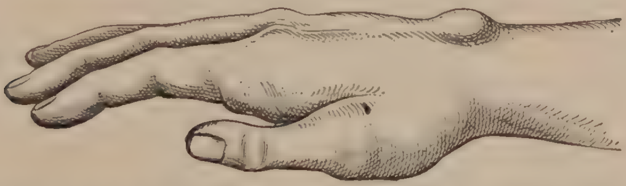

Fig. 352.—Ganglion of the wrist. (From Moorhead, "Traumatic Surgery.")

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[1] Carp, Louis, and Stout, A. P.: Surg., Gynec., and Obst., 47, 460, October, 1928.

The treatment of choice is the subcutaneous breaking of the ganglion by striking the overlying skin, with the ganglion made as prominent as possible, smartly with a book or by gradual pressure with the fingers. The expressed contents are probably absorbed and agglutination of the cyst wall may be facilitated by the wearing of a pad and snug bandage over the ruptured cyst for twenty-four to forty-eight hours. In some cases the breaking may require more than one session. In Carp and Stout's series 32 cases were treated by breaking, and of the 9 cases which were followed there was reappearance in 2 (22 per cent.). This is the method of choice for the first trial of treatment.

The second method is the surgical excision of the ganglion. This operation is very much more difficult than the excision of a sebaceous cyst, and should almost be classified as major surgery. Extreme precaution in regard to antisepsis should be taken because not infrequently the tendon sheath is opened. In order to get the entire ganglion including its base it may be necessary to actually excise a portion of the sheath. The operation should be performed under a general anesthetic, in a bloodless field secured by a blood-pressure apparatus tourniquet, with good light, small instruments, and ample assistance. In Carp and Stout's series 109 cases were treated by operation. Of these, 35 were followed up and reappearance was noted in 11 (31 per cent.). The operative method is to be employed when the breaking method has failed and when there are persistent symptoms and deformity.

The third method of treatment is the aspiration of the contents of the ganglion and the injection of an irritant, as carbolic acid or iodine. This method is uncertain, and in the cases of small ganglion may be extremely difficult. The point of the needle may fail to enter the ganglion, and the phenol will be injected into the tissues adjacent to it. The writer has seen a case of this kind in which extreme pain resulted and eventually sloughing of the soft parts. Some cases will disappear spontaneously without treatment.

(*b*) *Varix.*—Small varices of the upper extremity may advisably be treated by the injection of 50 per cent. glucose solution and the temporary occlusion of the vein, as has been described in the section on Varicose Veins. A more certain method is the complete excision of the varix under local anesthesia.

(*c*) *Aneurysm.*—Stab wounds and bullet wounds of the upper extremity may be accompanied by injury to arteries, with the resultant formation of an aneurysm. Of 172 cases of aneurysm at the Charity Hospital of New Orleans, Matas and Holcombe[1] found 2 of the brachial artery, 1 of the ulnar artery, and 1 of the radial artery. Stimson, among 55 cases of aneurysm, found 4 of the brachial and 3 of the radial arteries. In the smaller cases the artery may be exposed under local anesthesia, and ligated above and below the aneurysm. In the more severe cases involving the brachial artery treatment will be major surgical.

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[1] Keen's Surgery, W. B. Saunders Co., 1924, vol. v, p. 241.

(*d*) *Epidermoid or Occlusion Cysts.*—Deep lacerated wounds of the fingers particularly, but also of the hand or arm, may bring about the displacement of small bits of epithelium into the depths of the wound. These isolated portions of epithelium have been known to grow in their new situation and to form cysts. These cysts may take many years to develop, and when excised the lining of the cysts will be seen to have an epidermoid or epithelial character. The diagnosis is made by the palpation of a rounded nodule in the subcutaneous tissues. In a case operated by the author *x*-ray examination showed that the long-continued pressure of the cyst had caused a concavity in the adjacent bone.[1] The cyst may be slightly tender. The treatment of epidermoid cysts is their complete removal under local anesthesia.

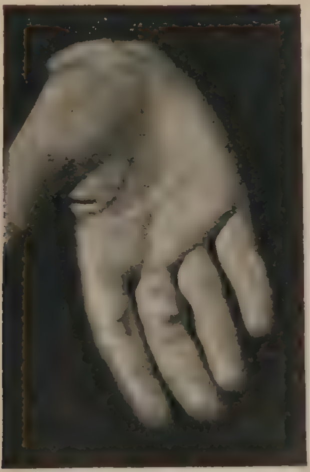

Fig. 353.—Racemose angioma (congenital arteriovenous communication). (Courtesy of Dr. Geza de Takáts.)

(*e*) "*Cutaneous horns*," (*f*) *papillomata*, (*g*) *fibromata*, and (*h*) *neurofibromata* are small benign tumors originating in the upper layers of the skin. They may readily be removed under local anesthesia or by fulguration and do not tend to recur. (See Warts.)

(*i*) *Granuloma* is the term occasionally applied to an excessive or exuberant granulation tissue and is found in wounds where the rate of formation of granulation tissue exceeds that of epithelization. The granulation tissue ("proud flesh") projects above the wound surface and, unless removed, delays epithelization. This type of tissue is insensitive to pain and may readily be removed by simply clipping off with a scissors, after which the bleeding base may be cauterized with silver nitrate solution or stick. Small amounts of excessive granulation tissue may easily be removed by cauterization with fused silver nitrate.

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[1] Christopher, Frederick: Epidermoid Cyst with Pressure Atrophy of the Adjacent Bone, Minnesota Med., September, 1925, p. 607.

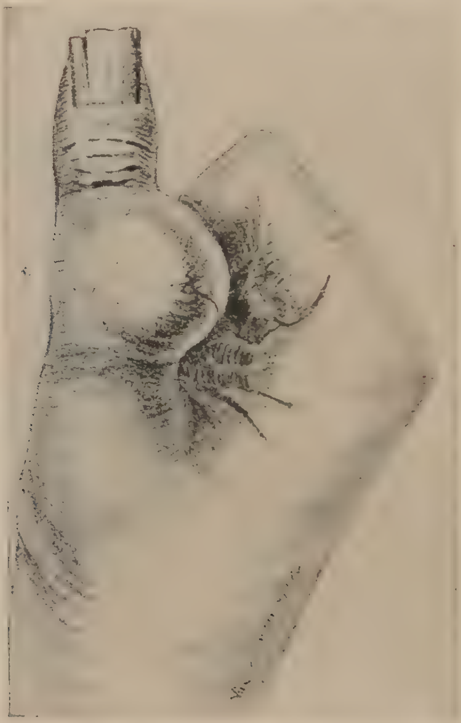

Fig. 354.—Xanthosarcoma of the thumb. (Vermooten, V., Ann. Surg., April, 1925, J. B. Lippincott, Publishers.)

(*j*) *Lipoma.*—The diagnosis of lipoma has been referred to elsewhere. There is no necessity for the removal of lipomata except for cosmetic purposes. In this case the excision is readily accomplished under local anesthesia.

Giant-cell xanthomatic tumors (**giant-cell sarcoma, xanthosarcoma**) are tumors whose cut surfaces are yellowish and which contain giant-cells. The tumor does not metastasize or cause death, but it is somewhat prone to local recurrence. These tumors take their origin chiefly from the tendon sheaths, but may also originate from subcutaneous tissue or other fibrous tissue. The writer has seen one which apparently arose from the aponeurosis of the forearm.[1] They grow slowly over several years, but trauma may cause a more rapid growth. Occurring as isolated growths of the fingers and hands, they are considered to be benign.[2] The tumors are more common in adult life, in females, and on the right arm or hand. They are more common on the flexor surface and in order of decreasing frequency they occur on the index-finger, the thumb (Fig. 354), the middle finger, the little finger, the palm, the ring-finger, and the wrist. Save for rare instances of pain or tingling along the finger, they are symptomless. Vermooten[3] reported a xanthosarcoma of the proximal phalanx of the thumb which was removed under local anesthesia by curettement. Cole[4] reported 2 cases of benign giant-cell tumors of the phalanges. "The first of these involved the proximal phalanx of a toe, and was cured five and a half years after amputation. The second involved the proximal phalanx of the thumb. The patient was well sixteen months after the phalanx was resected and replaced by a bone graft from the tibia, driven into the metacarpal head" (Cole). Duskes[5] reported a case of central giant-cell tumor of the third metacarpal bone of the left hand in a girl of seventeen years. The proper treatment for this type of tumor is thorough local removal under local anesthesia. A mutilating operation is unnecessary.

Tumors of Tendon Sheaths.—Janik[6] has made a study of primary tumors of tendons and concludes that they are rare. The commonest of them is sarcoma. Primary tumors of tendon sheaths are more frequent. The commonest are the giant myelomata. This is more properly a granuloma and should be more properly classified under inflammatory disease. The benign tumors which are found in tendons are fibroma, osteoma, and chondroma. The benign tumors of tendon sheaths are fibroma, lipoma, chondroma, and angioma. Three cases of lipoma of the tendon sheaths have been reported by Mannini.[7]

Trigger Finger and Stenosing Tendovaginitis of the Flexor Tendons of the Finger (Tendinitis Stenosans).—A careful anatomical study of 14 cases of this interesting condition has been made by Kroh.[8] According to Kroh, the disturbance of motility is often erroneously believed to be in the interphalangeal joint, whereas it always occurs at the level of the metacarpophalangeal joint at the point where the tendon sheath is narrowed by the accessory volar ligament.

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[1] Christopher, Frederick: Jour. Amer. Med. Assoc., 87, 167, July 17, 1926.
[2] Mason, M. L., and Woolston, W. H.: Arch. Surg., 15, 499, October, 1927.
[3] Vermooten, V.: Ann. Surg., 81, 851, April, 1925.
[4] Cole, Wallace H.: Ann. Surg., 83, 328, March, 1926.
[5] Duskes, Emile: Ann. Surg., 85, 912, June, 1927.
[6] Janik, A.: Ann. Surg., 85, 897, June, 1927.
[7] Mannini, R.: Policlin., Rome, 1928, 35, sez chir., 364.
[8] Kroh, F.: Arch. f. klin. Chir., 1925, 136, 240.

The trigger phenomenon may occur with flexion or extension or both of these movements. The inhibition of the tendon movement may arise as the result of localized thickening of the tendon with greater or less narrowing of the tendon sheaths due to thickening or chronic inflammation. In the latter condition the disturbance of motility may be due to pain and the phenomenon of slipping or jerking may be absent.

The treatment is relatively simple—excision of the volar portion of the diseased section of tendon sheath.

Microscopic examination of the extirpated specimen shows a hyperplasia of all of the elements of the tendon sheath. In a more advanced stage there may be fissuring and vascularization of the fascial tissue of the ligaments, and at an even later stage hyaline degeneration.

In none of Kroh's cases was it possible to obtain a definite history of trauma or chronic inflammation of the joints, in spite of the fact that the processes found in the tendon sheath suggested these factors. In every case the Wassermann test was negative. Instead of containing fluid, the tendon sheath was rather dry. In the cases with the trigger phenomenon the author found at the level of the proximal accessory band (the accessory volar ligament) a decrease in the caliber of the tendon sheath and peripheral to this a thickening of one or both flexor tendons.

Hanson[1] reports an interesting case of tendinitis stenosans in the abductor pollicis longus in a man of thirty-eight years. At operation the limitation of extension and abduction of the thumb was found to be due to a spool-shaped contraction of the tendon resulting from a partial rupture caused by a blow on the distal side of the styloid process of the radius. Normal motility of the thumb was restored by opening the tendon sheath.

The author believes that similar causes may be active in other cases of this nature. He reports this case as evidence of the fact that the tendon itself rather than the tendon sheath may be the site of primary changes.

Exostosis (Osteochondroma).—These are benign tumors of the bones which are composed of bone and cartilage. The average age is the third decade and the tumor occurs more commonly in males. Meyerding[2] believes that heredity and metabolic disturbances in childhood are most important etiological factors, and that trauma is of less importance than the histories suggest. In 265 cases at the Mayo Clinic Meyerding found 65 in the femur, 34 in the tibia, 30 in the humerus, and 26 in the foot. The symptoms are a hard swelling formation. Meyerding places stress upon the importance of *x*-ray in the diagnosis.

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[1] Hanson, R.: Acta chirurg. Scand., 1926, 60, 281.

[2] Meyerding, H. W.: Radiology, 1927, 8, 282.

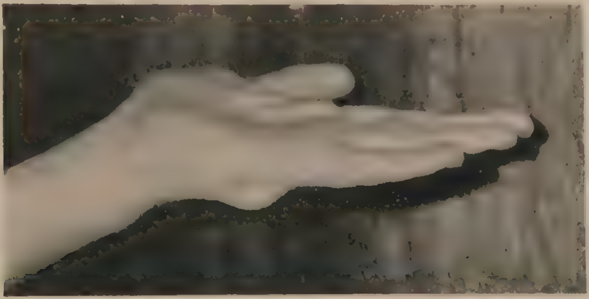

Fig. 355.—Enchondroma of metacarpal. (Surgical Dispensary, Northwestern University Medical School. Courtesy of Dr. John A. Wolfer.)

According to the roentgenographic findings of exostosis the cortical point of origin is in the diaphysis near the epiphyseal line, most commonly in the lower end of the femur and the upper end of the tibia and humerus. The base of the tumor varies from a narrow to a broad pedicle, and the tumor ranges from a bony projection to a pedunculated mass of varying size. The cortex of the bone and the pedicle of the tu-

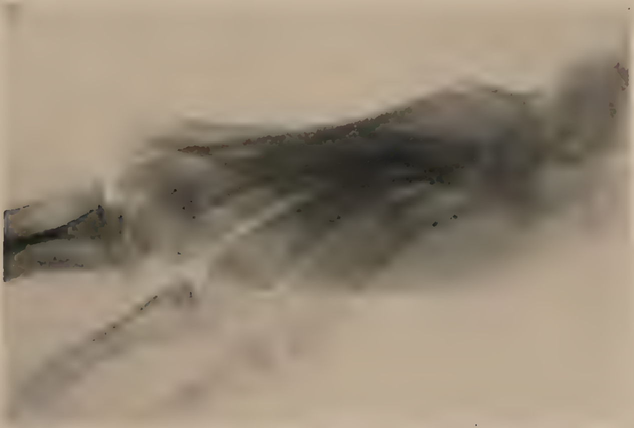

Fig. 356.—*x*-Ray of tumor shown in Fig. 355. Enchondroma of the thumb. (Surgical Dispensary, Northwestern University Medical School. Courtesy of Dr. John A. Wolfer.)

mor may appear to be continuous. A cartilaginous cap is common; frequently this has a cauliflower-like appearance. Inflamed bursæ may produce distended sacs. The tumors may be local or general. There is penetration rather than invasion of tissue. No absorption of bone occurs unless there is pressure on neighboring structures. The periosteum is expanded over the tumor which usually occurs away from the joints.

The treatment of these tumors is surgical when their presence causes deformity or pain. Cauterization of the base and the use of a rubber tissue-drain is advisable. In cases of single tumors the prognosis is good. Of the patients heard from after being dismissed from observation, 75 per cent. reported themselves cured. There was no surgical mortality.

In 89 cases of bone lesions of the hand and foot at the Johns Hopkins Hospital Kahn and Cohn[1] found the pathological diagnosis to be exostosis in 28, chondroma in 11, giant-cell tumor in 8, myxoma in 6, osteitis fibrosa in 4, sarcoma in 2, osteomyelitis in 2, epithelial line cyst in 2, hemangioma in 1, and ossifying hematoma in 1. The diagnosis of the largest group, the exostoses or osteomata, is rarely difficult. From the standpoint of treatment it is especially important that myxoma be recognized by the surgeon, as the use of the cautery offers practically the only chance for the cure of this tumor (Kahn and Cohn).

2. **Malignant Tumors.**—*Epithelioma*, *carcinoma*, and *sarcoma* occasionally are found on the upper extremity, but a discussion of them does not properly belong in the domain of minor surgery.

CONGENITAL AND ACQUIRED DEFORMITIES OF THE UPPER EXTREMITY

1. **Polydactylism (supernumerary digits)** occasionally is found in infants at birth. There is a marked hereditary element, and it may involve both fingers and toes. The classification of Annandale[2] is satisfactory: (1) A rudimentary digit loosely attached to any part of the hand or foot or to another digit. (2) A more or less developed digit, articulating with the head or side of a metacarpal, metatarsal, or phalangeal bone. (3) A perfect digit, with a metacarpal or metatarsal bone of its own. (4) A digit united in its length to another articulating with a metacarpal or metatarsal bone of its own, or with one shared with another digit. An extremely interesting case is reported by Penhallow.

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[1] Kahn, M., and Cohn, L. C.: Radiology, 8, 289.

[2] Annandale, T.: Malformation, Diseases and Injuries of the Fingers and Toes, Philadelphia, 1866, quoted by Lovett.

[3] Penhallow, D. P.: Jour. Amer. Med. Assoc., 91, 564, August 25, 1928.

In this author's case there was a complete absence of the thumbs on each hand, each thumb being replaced by two complete and functioning digits (Fig. 357). Because of the unsightly appearance amputation is indicated. The proper time to perform such an amputation is in the early weeks of the child's life, preferably in the first three weeks. *x*-Ray

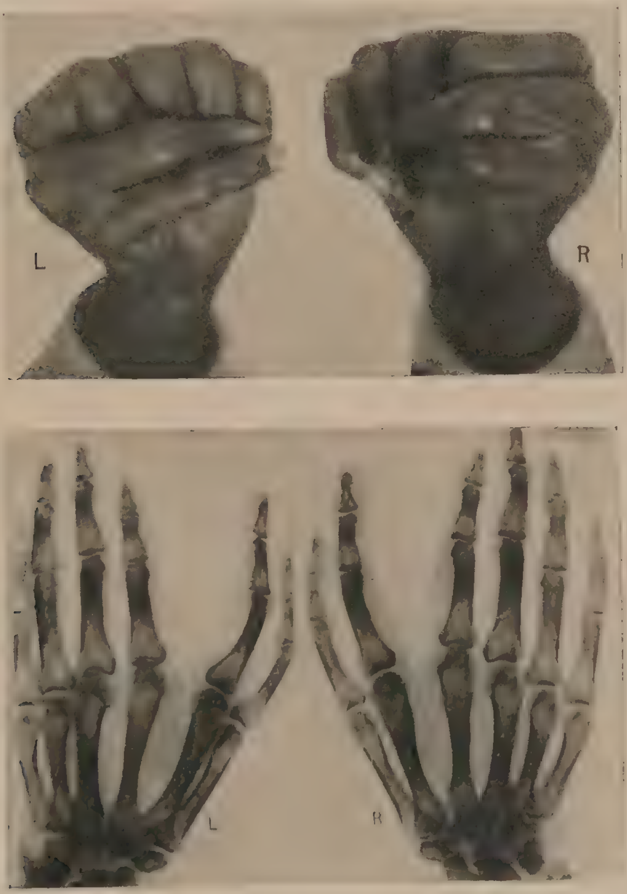

Fig. 357.—Supernumerary digits. Below: *x*-ray showing perfectly formed metacarpals and phalanges. (Penhallow, D. P., Jour. Amer. Med. Assoc., August 25, 1928.)

examination should invariably be made in order accurately to identify which of the phalanges are superlative or if there be an exostosis at the side of any of the phalanges. The supernumerary digits may readily be amputated under general anesthesia, induced by a few drops of ether. The extra phalanges should be disarticulated and the skin closed with two or three interrupted horsehair or dermal sutures. In the case of a supernumerary thumb it is not uncommon to find the supernumerary thumb and the thumb proper are of about equal size and diverge from a common stalk in the manner of a Y. The smaller thumb will always be removed (Fig. 358). After its removal the parents will always be troubled by the lateral deflection of the remaining digit. The correction of this deflection by splinting is generally not very successful. It is usually adequately taken care of by the growth of the child and by the continued use of the digit. A straight digit may be promised with reasonable surety. In adults, or in cases where the strength of the hand might be jeopardized, operation may be contraindicated.

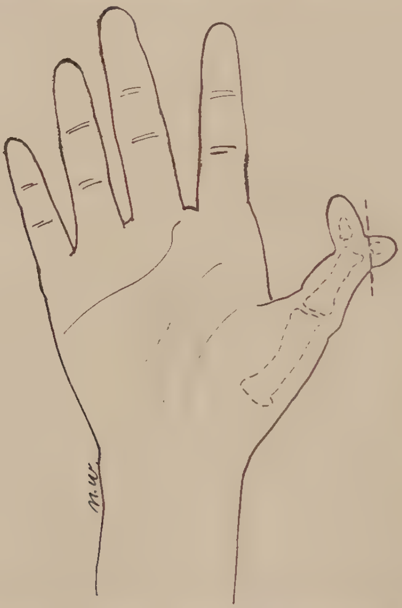

Fig. 358.—Diagram showing amputation of the smaller digit in a case of polydactylism.

2. **Syndactylism or Web Fingers.**—Congenital webbing of the fingers is a relatively common anomaly. The web may involve the spaces between any of the fingers, or the index-finger and the thumb, and may be of varying length, in some cases extending even to the finger-tips. Lovett[1] classifies syndactylism into four groups: (1) The union may consist of a thin membrane. (2) The uniting structures may consist of skin which may exist merely as an extension of the normal one. (3) The connection between the two fingers may be a firm structure of skin and fascia fusing the two fingers into one, with perhaps only a single nail for the two. (4) Finally the union may be osseous, generally

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[1] Lovett, R. W.: Keen's Surgery, W. B. Saunders Co., vol. ii, 1924, p. 572.

affecting the terminal phalanges, but also at times causing a fusion of all the bones of the two fingers. Before operation to correct this condition is undertaken *x*-ray examination should be made. A variety of surgical procedures have been suggested and employed for the correction of the deformity, but probably the most satisfactory is the Didot operation. By this operation one web at a time is corrected. Where the little and ring fingers are involved, a longitudinal incision will be made upon the volar surface of the ring finger and the dorsal surface of the little finger. The flaps will then be separated back and rearranged so that the volar flap is turned up on the dorsum of the little finger and the dorsal flap is curved under the volar surface of the ring finger. The flaps are secured in position by interrupted horsehair stitches or dermal sutures (Fig. 359). A dry dressing is applied.

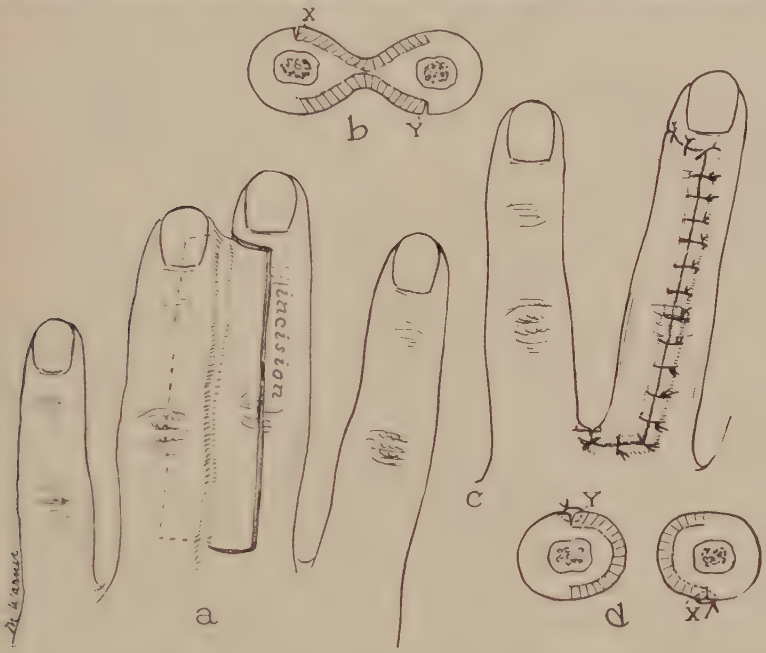

Fig. 359.—Didot operation for syndactylism: *a*, **Dorsal incision; volar incision indicated by dotted line.** *b*, **Cross-section showing incisions at** *x* **and** *y*. *c*, **The volar flap has been carried to the denuded dorsal surface of the finger.** *d*, **Cross-section showing arrangement of flaps at the completion of the operation.**

3. **Congenital Hypertrophy of the Finger.**—No treatment is required for this rare condition except in those cases where the finger is so large as to interfere with the function of the hand. In this case the entire finger or the distal two phalanges may be amputated under local anesthesia.

4. **Congenital Absence of Fingers.**—In this unusual condition one or more fingers may be completely absent (Fig. 360).

5. **Congenital Dystrophies of the Nails.**—This interesting condition is very unusual. Jacobsen[1] reported a case of congenital dystrophy of the nails of the hands and feet. The condition is hereditary. Of 64 members of five generations, Jacobsen found 22 to be affected. This author believes thyroid therapy worthy of a trial. In Thompson's case[2] the brittle dry nails were apparently helped by *x*-ray. Thompson believes that the incidence decreases with succeeding generations.

6. **Congenital Contracture of the Palm.**—Jorge[3] reports a case of a congenital contracture of the hand in a three-year-old girl whose mother had a similar contracture which had been present since her birth. The Wassermann reaction was positive in both mother and daughter.

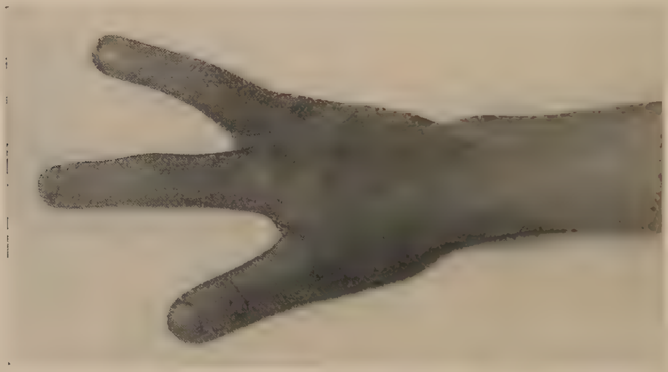

Fig. 360.—Congenital absence of fingers. (Children's Memorial Hospital, Chicago. Courtesy of Dr. Joseph Brenneman.)

7. **Madelung's Deformity.**—In this condition there is an abnormal curvature of the radius, and a more or less marked dorsal luxation of the lower end of the ulna. This disease usually develops between the ages of twelve and sixteen years, and is rare in early childhood. It is four times more common in females than in males. It is generally bilateral and more marked on the right than on the left. Madelung[4] thought the immediate causes of the deformity to be found in a retarded growth of the joint. DaCosta suggests the etiological influence of heavy work before childhood.[5] Catterina[6] concludes that the cause is a late form of

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[1] Jacobsen, A. W.: Jour. Amer. Med. Assoc., 90, 686.

[2] Thompson, H. B.: Jour. Amer. Med. Assoc., 91, 1527.

[3] Jorge, J. M.: Rev. d'orthop., 1926, 33, 97.

[4] Madelung, O. W.: Arch. klin. chir., 23, quoted by Lovett.

[5] DaCosta, J. C.: Modern Surgery, 9th ed., W. B. Saunders Co., 1925, p. 633.

[6] Catterina, A.: Chir. d. organi di movimento, 1926, 10, 517.

rickets developing in adolescence, and that the deformity is increased by forced dorsal flexion of the hand in the patient's work, this accounting for its being more marked on the right side. This author says that, as a rule, the condition is painless, while Lovett[1] says that pain is a common symptom. The latter adds that the function of the hand is most disturbed in the direction of rotation and hyperextension, which is painful, while flexion may be increased. Orthopedic treatment gives good results if it is begun in the early stages. Surgical treatment should be given only in very severe cases, and should consist in an oblique linear osteotomy of the lower third of the radius (Catterina).

8. **Cicatricial contractions** following burns by heat or strong chemicals may be so marked as to interfere with the functions of the hand. When the case is of lesser degree, no treatment will be necessary, the use of the hand and the elasticity of the adjacent skin will overcome the defect to function. In the more marked cases the excision of the scar tissue and the substitution of a full thickness, pedicle flap, or tubular graft is a difficult surgical procedure which does not belong to the realm of minor surgery.

9. **Dupuytren's Contracture.**—In this condition there is permanent flexion of one or more fingers, due to a contraction and hypertrophy of the plantar fascia and its digital prolongations. The ring finger is most frequently involved, with the little finger, middle finger, fore-finger, and the thumb following in order of frequency. It was first described by Dupuytren in 1832. The cause is not definitely known, but the three theories, according to Kanavel, Koch, and Mason,[2] are first, the etiological relation of trauma; second, that it is "a constitutional vice like gout or rheumatism"; and third, the theory of inheritance. Of the three, the hereditary influence at present seems to be the most plausible. The condition is more common among males. Cokkalis[3] gives credence to the theory that Dupuytren's contracture is a tendon structure of muscular origin. There are few if any subjective symptoms. The objective symptoms begin with a nodule or nodules in the palm of the hand, and a gradually increasing contracture which may take as much as years to develop. Kanavel, Koch, and Mason (loc. cit.) have operated upon 29 cases and have obtained good results in 20 cases. These authors state that they place importance upon the following factors:

"1. Wide excision, not only of the contracted fascia, but of all its attachments to the skin, the interfascial septa, the volar interosseous fascia, the metacarpal bones, and the phalanges. Although in such an operation normal fascia may be removed, they do not consider this a disadvantage, but rather an added guarantee against recurrence.

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[1] Lovett, R. W.: Keen's Surgery, W. B. Saunders Co., vol. ii, 1914, p. 542.

[2] Kanavel, A. B., Koch, S. L., and Mason, M. L.: Surg., Gynec., and Obst., 48, 160, February, 1929.

[3] Cokkalis, P.: Deutsche Zeitschrift f. Chir., 1926, 194, 256.

"2. Careful dissection and elevation of the skin to avoid trauma and subsequent necrosis.

"3. Painstaking effort to avoid injury or division of the digital nerves and blood-vessels which are frequently embedded in the bands of fibrous tissue which draw the fingers into flexion.

"4. Excision of skin that is hopelessly involved, and replacement of the excised skin by a free full thickness graft rather than attempting to bring together wound edges under tension.

"5. In long-standing cases, with marked contraction of the fingers, excision of the head of the proximal phalanx, and shortening of the extensor tendon of the affected fingers through a dorsal incision (Hutchinson's operation).

"6. Active movement of the fingers and hand as soon as the operative wound is soundly healed."

Practically all cases may be operated upon under regional local anesthesia, ½ per cent. procaine without adrenalin being suitable. When the operation is done under local anesthesia, the co-operation of the patient in moving the finger during the operation, thus revealing the time when the fascia is sufficiently removed, is very helpful (Webb). A transverse incision is made in the lesser cases, and in the more severe cases a longitudinal incision of length adequate to expose the entire fascia will be employed.

10. **Volkmann's Contracture (Ischemic Contracture)**.—This condition is a manifestation of interference with the venous return flow of blood. In the first stage (Allison) edema, cyanosis, and lowering of surface temperature are present. Pain and altered sensation may be marked. In the second stage "there is progressive fibrosis of the muscles, resulting in a fibrous change in all the tissues, with progressive loss of motion, with varying degrees of anesthesia, but without the true reaction of degeneration. The pulse volume is reduced, and the sensory disturbance is irregular in distribution" (Allison). The condition is due to an overengorgement of the muscle bundles with blood. Jopson[1] says that the intrinsic pressure causes local myositis and pressure on the nerves, usually the median and ulnar, and upon the blood-vessels. According to Jopson, flaccid paralysis develops, followed by a swelling of the muscles. Volkmann's contracture is particularly liable to occur

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[1] Jopson, P. N.: Ann. Surg., 84, 785, 1926.

after the application of tight splints or bandages. It has been known to occur, however, in the absence of constricting dressings. It also may occur in forearm fractures and even with fractures of the clavicle. In no event should constricting bandages or plaster of Paris be applied when the swelling is still in progress. For elbow fractures the Lund swathe or similar dressing is much to be preferred. It must be remembered that where the elbow is put up in hyperflexion, this position coupled with increased swelling may bring about such an obstruction to the circulation that the arm will have to be lowered to a right angle or, in extreme cases, incision of the bicipital fascia will be necessary. Hey Groves[1] says that full flexion of the elbow can be just as dangerous as a tight bandage. All recent fractures must be kept under close observations. With the onset of edema, cyanosis, lowering of surface temperature, and increase in pain all dressings should be loosened or removed entirely. At times, incision in the arm through the fascia is indicated to obtain relief from the congestion, and help restore normal circulation (Webb).

11. **Deformities of the Upper Extremity Due to Nerve Injuries.**—In case of section of any of the motor nerves of the upper extremity, with paralysis of the muscles which they innervate, the contraction of the opposing muscles will cause a flexion or extension, as the case may be, of individual fingers, the hand, or even of the forearm. The paralyzed muscle is subjected to a continuous pull which overstretches it, and the normal opposing muscle being in a continued state of colonic contraction is likely to become actually shortened. This danger is prevented by splinting the fingers or hand so as not to permit this overstretching until the nerve has regenerated.

12. **Tattoo Marks.**—Many proud wearers of tattoo marks lose their pride after a period of years, and are extremely anxious for their removal. The tattoo marks themselves are permanent discolorations of the skin. The writer has heard that there are people who make a specialty of re-tattooing the offending marks with a whitish substance which blurs them and makes them unrecognizable. Small tattoo marks may be completely excised. Larger ones up to 3 or 4 inches in diameter may sometimes be treated by the process of repeated excision. A central area, perhaps 1 inch across and ellipitcal in shape, is excised and sutured. Some months later, when union is firm and the normal elasticity of the adjacent skin has been re-established, a second process may be repeated until eventually all of the tattoo mark has been cut out (Figs. 361–363). Another method is the excision of the tattoo mark and

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[1] Groves, E. W. Hey: Lancet, 214, 167, January 28, 1928.

subsequent skin-grafting. Electrolysis and various chemicals, as phenol, carbolic acid, have been used. Blistering of the skin followed by hydrogen peroxide in glycerin or 15 to 20 per cent. solution of silver nitrate are among the remedial agents tried. A very interesting study of this subject has been made by Shie.[1] This author believes the best method of tattoo removal to be the tannic acid and silver nitrate method of Variot[2] when used with certain modification which Shie has developed.

Fig. 361.—Diagram of tattoo mark of arm.

The following is the method as related by Shie: "The area involved is prepared as for a surgical operation. A 50 per cent. solution of tannic acid in water is then tattooed into the design, care being taken that the solution is carried well into the corium. The area is painted with the tannic acid solution and, as the tattooing progresses, an assistant adds fresh tannic acid from time to time with a cotton tampon, so that the tattooing is always done through the solution. The skin must be tightly stretched during the operation to minimize the discomfort and to favor penetration of the chemical to the proper depth. The tattooing can be done in several ways. The simplest is to use a cork into which six or eight fine cambric needles are closely embedded. I (Shie) find that a short piece of $\frac{3}{4}$-inch brass tubing into the slightly flattened end of which are soldered ten fine needles is more convenient and less fatiguing to the fingers. If a dental engine is available, a fine drill will work very well, but care must be taken not to apply enough pressure to cause the drill pressure to puncture the corium or some scarring will result. For outline tattooing or names, probably the easiest and best

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[1] Shie, M. D.: Jour. Amer. Med. Assoc., 90, 94, January 14, 1928.

[2] Variot, G.: Les tatourages, Re. Scientifique, May 12, 1883; Nouveau procédé de destruction des tatouages, Compt. rend. Soc. de biol., July, 1888; Les tatouages et les peintures de la peau, Re. Scientifique, 1889: Variot, G., and Raoult, M., Recherches sur les tatouages des piquqerers et des meules, Gaz. méd. de Par. 1891, No. 50.

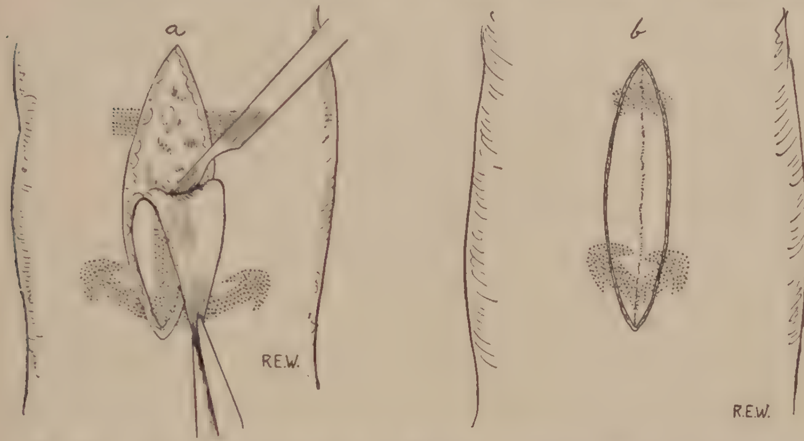

Fig. 362.—Removal of tattoo mark: *a*, Elliptical excision of part of the tattoo mark; the edges are approximated by suture. *b*, After the wound of the first operation has thoroughly healed, a second elliptical incision is made.

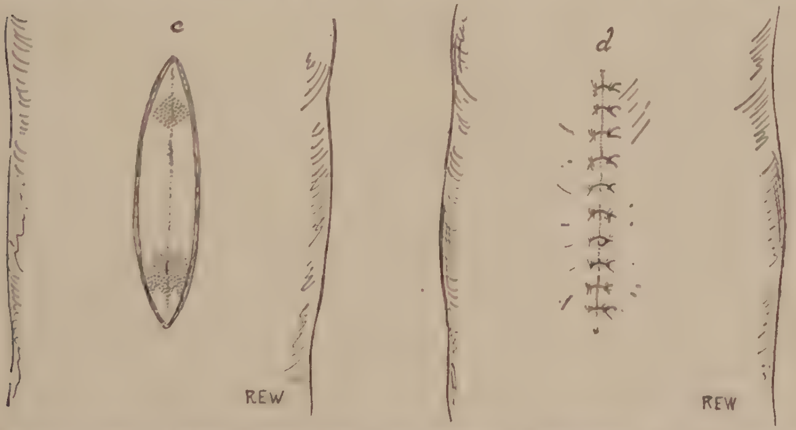

Fig. 363.—After the second incision has firmly healed, if necessary, a third incision is made (*c*). *d*, Wound after final removal of the scar.

instrument to use is an electric tattooing needle. The solution must be tattooed thoroughly into the whole design; care must be taken to tattoo it deeply into the corium along the edges of the mark where the pigment usually lies deepest. If a dental drill is used, it is applied perpendicularly along the outline of the mark, making individual contacts. The remainder of the mark is treated by moving the rapidly revolving drill back and forth across the design, enough pressure being used to macerate the epithelium and to embed the solution into the corium.

"As the operation progresses, the design becomes gray in tint, somewhat hard to the touch, and elevated above the surrounding skin. When it is completed, the entire design is closely covered with needle marks and the pigment is almost obliterated by the gray tint and by numerous fine droplets of blood. The excess of tannic acid is then removed from the surrounding area by washing with cold water. Sterile petrolatum or collodion is applied to the adjacent skin, a clean margin of about $\frac{1}{4}$ inch being left around the edges of the design. This is done to prevent discoloration of the skin during the next stage. A stick of silver nitrate is then rubbed vigorously into the treated area, forming a heavy black deposit of silver tannate in the corium. When this step is completed, the design itself and the gray discoloration made by the tannic acid are entirely obliterated by the silver tannate. The petrolatum is wiped off and the field washed with cold water. If there is any doubt as to the thorough penetration of the silver tannate into the corium, it is well to dress the wound with some of the tannic acid solution; otherwise a sterile dry dressing is all that is required. The operator should wear rubber gloves to avoid troublesome deposit of silver tannate on his own fingers.

"There is surprisingly little pain connected with this procedure, no anesthetic of any sort being required for any except the most sensitive areas, such as the face, or unless there is a large mark to remove. At the outset the patient occasionally winces a little, but as the tattooing is continued steadily and rapidly, the sensation of pain largely disappears. If it is done slowly and deliberately there is some pain, just as when a hypodermic needle is pushed slowly into the skin, but when done with quick, rapid taps of the needles, there is almost none. There is even less pain with the electric needle, and with the dental drill there is scarcely any unless the drill punctures the corium and penetrates the subcutaneous tissue.

"There is very little reaction following the operation, certainly no more than that following the original tattooing. There may be slight swelling and redness around the edges, but I have never encountered any reaction greater than this. In two or three days the dressing may be discarded. The tattooed area gradually becomes hard and dry, and slowly separates from the deeper layers of the corium. In about twelve or sixteen days the black, dry slough comes off in one piece resembling a thin piece of leather. This contains the epithelium, the silver tannate in the corium, the superficial layers of the corium, and the tattoo pigment. While this eschar has been separating, a thin new layer of epithelium has formed beneath it. This remains pink for some time, but gradually takes on the color of the surrounding skin. Occasionally, it will be found that a few small deposits of pigment remain, usually along the edge of the tattoo mark, where they have been deposited deeper than in the remainder of the design. They can readily be treated again by the same method.

"Whether or not scarring results depends on the depth of the hair follicles; as most of it is, it can be removed in many cases without scarring. If it is so deep that the hair follicles are destroyed with the tattoo mark, some scarring will occur.

"As the histologic changes of old powder burns and other cases of accidental tattooing are precisely the same as those of tattooing, except that in some cases the carbon is embedded somewhat deeper than the tattoo pigment, it follows that they may be removed in the same way. With these cases, however, it is well to raise the edge of the separating slough in about ten days to discover whether all of the carbon deposit has disappeared. If not, the slough should be removed at this time, and the moist area beneath gently curetted with a trachoma rasp or similar instrument. Compresses of equal parts of hydrogen peroxide and glycerin are then applied, and are continued until all the carbon has been removed. When this is necessary, healing is somewhat delayed and, of course, some scarring results because the foreign matter lies deep; but the scar has the appearance of one following a superficial burn and is much less disfiguring than the original blemish. If one sees cases of accidental tattooing within twenty-four hours after the accident has occurred, it is of course easy to remove the débris from the corium by other methods before disfiguration has occurred."

CHAPTER XXI

INJURIES OF THE LOWER EXTREMITY

1. Contusions, Abrasions, and Blisters.—The treatment of contusions and abrasions of the lower extremity is identical with that described elsewhere previously. The same may be said of blisters. The heel is a particularly common site of blister formation from the traumatism of a too tight or ill-fitting shoe. Where the friction of the shoe is noticeable and recurrence of a blister seems likely to take place, a very useful prophylactic measure is to place a broad strip of adhesive plaster directly on the skin at the affected site. Should the small blister actually develop it is best protected by removing all friction and pressure, by painting with alcohol, dilute iodine, or mercurochrome, and covering by a small dressing held firmly in place by adhesive plaster. The dressing may be cut in the form of a ring to protect the irritated area. This protection should be maintained until the upper layer of the blister has become dry and scaled off. Should the blister be very large, it may be aspirated through the intact skin at its border in the manner previously described (Fig. 364). If there be evidence of infection within the blister, or of actual pus, the roof of the blister should be excised and its floor painted with mercurochrome and a plain white or borated vaseline dressing applied. If the blister be accidentally torn open by the patient, but still appears to be uninfected, the application of a mild antiseptic and a sterile dry or vaseline dress-

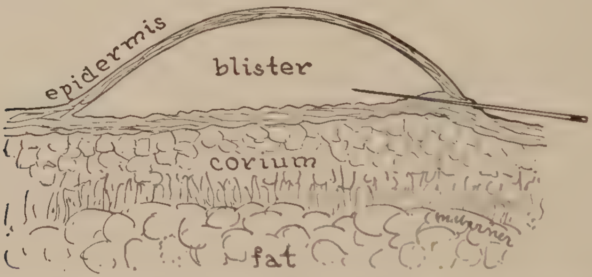

Fig. 364.—Most blisters are better left undrained. If they require drainage, puncture is made under sterile precautions through the unaffected skin at the side to preserve the covering of the blister.

ing will generally take care of the condition until the wound has healed. Should, however, infection be present the roof of the blister should be cut away and the floor treated as above described.

Neglected heel blisters may have very serious consequences. At the present writing the author has in the hospital a boy of fourteen years who developed a multiple osteomyelitis from an infected heel blister. In addition to the blister his first symptom was a painful swelling of the calf of the leg. The knee was held acutely flexed to release the tension on the calf muscles. The point of greatest tenderness was over the fibula. The infected blister was treated with hot boric fomentations and soon a small abscess discharged spontaneously. A long incision was made over the fibula and a large subperiosteal abscess was opened up. Drill holes into the marrow of the fibula permitted pus to escape from the inside of the bone. A day or two later the mandible became involved. It became swollen and tender, and large quantities of pus escaped from the gingival border beside the loosened teeth. Both sides of the lower jaw were involved. Tender areas developed in the region of the right pectoralis major and at the lateral border of the right scapula. These latter, however, subsided under hot boric fomentations. The blood-culture was positive for staphylococcus. The patient's temperature is gradually becoming lower and he seems to be recovering.

2. **Hematomata** are treated as has been previously described. Severe blows involving the calf or the thigh are prone to cause hematomata within or beneath the muscles. Most frequently these hematomata will subside under rest and elevation. Occasionally, however, they may be so large as to cause an interference with the circulation because of their pressure. In this event, an attempt should be made to aspirate, under strictest sterile precautions, the contents of the hematoma, which may be successfully accomplished if the blood be fluid. If the blood be clotted, the contents will have to be evacuated through an incision which, of course, must be made under rigid sterile precautions. After the evacuation of the hematoma a snug but not tight bandage is applied to approximate the walls of the hematoma.

3. **Traumatic Arterial Hematoma.**—In this condition there is an injury to the wall of an artery. There is severe pain, swelling, and coldness below the injury, and an absence of pulse in the periphery. The swelling itself may be pulsating and give rise to an audible bruit. In the case of smaller arteries the swelling is slow of formation and the pulsation is a late symptom. In the latter cases surgical intervention is not urgent and may be delayed until the collateral circulation has im-

proved—a period of two or three weeks. In the larger artery wounds operation may be very urgent to prevent gangrene from disturbance of circulation. In some cases the injury may be so grave as to require amputation because of the destruction of the major blood-supply of the extremity. At operation the limb is elevated and emptied of as much blood as possible. An Esmarch bandage is then applied below the wound or injury, and after evacuating the clot the vessel is ligated above and below the injury. In the larger vessels the major surgical procedure of vessel anastomosis is to be considered.

4. **Rupture of Varicose Veins.**—Varices and varicose veins of the lower extremities are liable to rupture spontaneously (especially in the neighborhood of varicose ulcers) or following traumata which often may be trivial. The resulting hemorrhage may be very severe and, despite the fact that it is very readily controlled, may even be fatal. The writer has seen one such case. The common error in the treatment of cases of this type is the improper application of the tourniquet. Here the tourniquet is placed above the wound and applied tight enough to obstruct the venous circulation, but not the arterial, and the bleeding will be more severe than if the tourniquet be not applied. Simple direct pressure upon the bleeding point will control all cases. The relief is more prompt if, in addition, the extremity be elevated. The wound is sponged with an antiseptic solution, and is covered with a large pad of sterile gauze which is smoothly and firmly bandaged in place, taking great care that the turns of the bandage *above* the wound are not too tightly applied. In the absence of antisepsis sterile gauze, clean towel, or handkerchief may be pressed on the wound by hand. It is extremely rare to have to open such wounds and ligate the bleeding vessels.

5. **Hemorrhage into Joints (Hemarthrosis).**—Hemorrhage into the joints of the lower extremities may occur as a result of wounds of joints, blows in the neighborhood of joints, and of severe wrenches with tearing of the ligaments. The treatment will be rest and repeated aspirations under strict aseptic precautions.

The immobilization of the injured leg in a plaster cast or Thomas splint with elevation may be necessary. See pages 380 and 509 for further details of the treatment of joint injuries. The method of knee-joint aspiration will be seen in Fig. 369.

6. **Rupture of Tendons.**—The treatment of this condition is identical with that described previously (page 375).

7. **Rupture of Muscles.**—The general principles of the treatment of this condition are the same as those described for this condition elsewhere (page 379). The commonest injury of this type in the lower ex-

tremity is *tennis leg*. In 1921 Grassheim[1] analyzed over 500 cases of muscle and tendon tears, and found that the order of frequency of the different situations was as follows: (1) Tears of spinal muscles; (2) tears in calf muscles; (3) tears in quadriceps muscles; (4) tears in adductors of the thigh ("rider's thigh"); and (5) tears in the biceps of the arm (here the tendon most frequently ruptures). In *tennis leg* there is a rupture of certain fibers of the plantaris muscle, of the plantaris tendon itself, or even of certain muscle-fibers of the soleus or gastrocnemius muscle. The patient sustaining this injury will have been indulging in some violent exercise, as tennis or running, and will experience a sudden acute pain in the calf of the leg. The muscles have been thought to tear more easily when tired. Very commonly, he will say that he has looked about to see who has thrown a stone at his leg, and the pain and disability may be very great according to the degree of the rupture. An English surgeon (Wharton P. Hood quoted by Binnie) found to his astonishment that in those cases where patients disobeyed his instructions to keep the leg strictly immobilized either in a splint or cast, but used the extremity as much as they were able to, recovered much more rapidly than with the conventional treatment in vogue. Cases that have been treated by prolonged immobilization are found to have pain and stiffness for a very long time, occasionally many months. This is due to the fact that the immobilization encourages the organization of the effused blood and the laying down of scar tissue and painful adhesions, binding the affected muscles to the adjacent parts. In these cases the patient should be encouraged to walk and use the extremity as soon as possible. Gentle massage, heat, and counterirritants may accelerate the recovery. In the more painful cases a few days of rest and external heat are permissible, but the patient is advised to use the leg as soon as possible. Where walking is very painful, strapping with adhesive plaster or the application of a firm elastic bandage will be helpful.[2]

Partial ruptures of the quadriceps tendon are evidenced by pain on attempts to extend the leg, by localized tenderness, and occasionally by an actual depression at the site of the injury if seen immediately after the injury. The case of partial rupture does very well with prolonged immobilization in a plaster cast (four to six weeks) and the use of physiotherapy during the guarded resumption of walking.

8. **Wounds of the skin** of all varieties have been described elsewhere.

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[1] Grassheim: Monatsschrift f. Unfallsheilk., 29, 313, April, 1922, quoted by Gottlieb, A.: Arch. Surg., 9, 613, November, 1924.

[2] Christopher, Frederick: Early Mobilization in "Tennis Leg," Med. Jour. and Rec., June 1, 1927.

Wounds of *joints*, *tendons*, and *nerves* may likewise be found on pages 375, 379, 380. Williams[1] reports the end-results of immediate active mobilization of joint injuries in 20 cases, including 15 knee-joint injuries and 4 injuries of the elbow. Fifteen were not infected; in 5 there was a purulent arthritis. In the non-infected cases the disability averages 5 per cent., while in the infected cases it averages 12 per cent.

9. **Effusion into the Knee-joint; "Water on the Knee."**—This subject has been discussed in the section on Synovitis. To recapitulate, it may be said, however, that effusion into the knee-joint is a symptom of all types of knee-joint injury. It is important to ascertain the underlying injury and to properly treat it rather than to treat the effusion as an entity in itself. Where there has been no gross rupture of ligaments, no displacement or injury to semilunar cartilages, or no injury to the spine of the tibia and where the mechanical structures of the knee-joint is grossly undisturbed, the effusion may be treated by itself. Here rest, repeated aspiration, and early joint motion, together with external heat, diathermy, and massage are of value. In the more severe cases a circular plaster cast will be applied for four to six weeks and followed by physiotherapy.

10. **Bursitis of the Lower Extremity.**—(*a*) *Bursa of the Great Trochanter.*—This bursa lies between the great trochanter of the femur and the overlying muscle. When inflamed it causes pain or outward rotation of the thigh. In cases where the bursa has become distended the condition may be accompanied by abduction and eversion of the thigh and the patient may present somewhat the picture of hip-joint disease, from which condition a differential diagnosis must be made.

(*b*) *Ischiogluteal Bursa.*—This bursa, which lies between the tuberosity of the ischium and the overlying soft parts, becomes inflamed in individuals whose occupation entails constant sitting. Inflammation of this bursa has been referred to as "weaver's bottom." A distended ischiogluteal bursa, according to McWilliams, may press upon the pudendal nerve and cause referred pain over the distribution of the nerve.

(*c*) *Obturator Bursa.*—This bursa lies between the tendon of the obturator muscle and its bony exit from the pelvis. When inflamed the diagnosis may be made by the palpation of the tender exit of the obturator tendon by rectal examination. This condition may simulate coxitis (inflammation of the hip-joint).

(*d*) *Iliopectineal Bursa.*—Inflammation of this bursa, which lies immediately over the capsule of the hip-joint, will cause tenderness in the lateral portion of Scarpa's triangle. When distended it may press upon the femoral nerve and cause pain which radiates down the leg and which appears in the knee, as in cases of hip-joint disease.

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[1] Williams, C.: Practitioner, 1927, 118, 48.

(*e*) *Prepatellar Bursitis* ("*Housemaid's Knee*").—McWilliams[1] describes 14 bursæ about the knee. He states that the subaponeurotic prepatellar bursa is present in 88 per cent. of patients over the lower half of the prepatellar bursa (Fig. 365). Early acute cases of prepatellar bursitis generally will yield promptly to rest, avoidance of further traumatism, and warm applications. A circular pad may be placed around the irritated area so as to protect it. In more severe cases aspiration of the bursa and the injection of a caustic substance, such as phenol or iodine, have been recommended. This treatment, however, is uncertain and not entirely free from danger. In infected cases with suppuration, the bursa should be drained by a generous incision and packed. In the severe chronic cases of prepatellar bursitis incision and packing may be of benefit, but the treatment of choice is the excision of the bursa. This may be accomplished under local anesthesia. A curved incision is made with the convexity upward and enclosing the bursa. The skin flap is retracted downward and the bursa excised as far as possible. It may be impossible to completely excise the floor of the bursa, but as much of the serous surface as is possible may be removed. Any portion which remains should be treated with carbolic acid and neutralized with alcohol. Closure is made without drainage. The patient is kept quiet for several days, and then careful walking permitted.

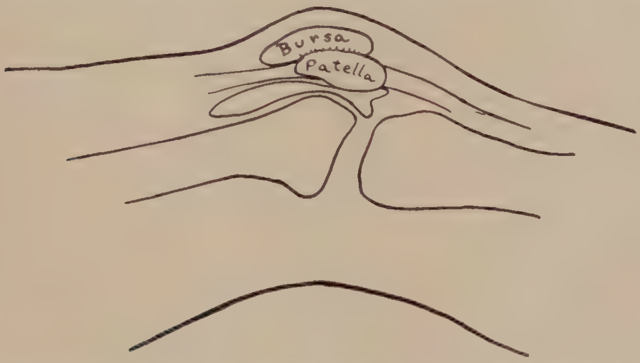

Fig. 365.—Diagram to show common location of prepatellar bursa in "housemaid's knee."

McWilliams states that there are about ten bursæ of importance about the foot and ankle. The following are included among them:

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[1] McWilliams, C. A.: Lewis, Practice of Surgery, W. F. Prior Co., Inc., vol. ii, chap. 5, p. 74.

(*f*) *Bursa Between the Tendons of the Extensor Digitorum Longus and the Prominent Overlying Talus (Astragalus).*—This bursa is irregular in extent, and inflammation of it will cause a tender area on the dorsum of the foot.

(*g*) *Retrocalcaneo Bursa.*—This bursa lies between the tendo achillis and the tuberosity of the os calcis. Excessive walking coupled with traumatism of stiff boots or skating or running is liable to cause inflammation of this bursa, a condition which is spoken of as achillodynia.

(*h*) *Subcutaneous Bursa Over the Tendo Achillis.*—This bursa likewise becomes inflamed after excessive walking in stiff boots or shoes.

(*i*) *Inferior Subcutaneous Bursa Under the Heel.*—This bursa which lies immediately beneath the tuberosity of the os calcis becomes inflamed with excessive walking, and a painful heel results. This condition should be distinguished from the pain caused by a low-grade inflammation of the insertion of the plantar fascia which may often be accompanied by calcaneal spurs.

(*j*) *Bursæ over the Malleoli.*—These bursæ are inconstant. When present, the bursa over the external malleolus is spoken of as "tailor's bursa," and may become inflamed by the irritation incident to sitting crosslegged.

McWilliams has given us excellent advice on the general principles of the *treatment of bursitis.* The most important measure is rest and avoidance of pressure or friction between the inflamed surfaces of the bursa. The latter often may be accomplished by strapping the bursa or rest in bed. If the bursa becomes very distended, aspiration or repeated aspirations will be of value. Neglected cases of acute bursitis may be transformed into cases of chronic bursitis or chronic bursitis may develop without the occurrence of an acute stage. Chronic bursitis has been treated by repeated injections of iodine, but cure by this method is uncertain. The best methods of treating bursitis are surgical. The bursa may be incised and packed with iodoform or plain gauze. As the packing is gradually withdrawn, the serous surfaces of the bursæ become inflamed and adhere to each other, thus obliterating the bursal cavity. The surest method of all is the complete excision of the bursa. As has been mentioned in connection with prepatellar bursa, complete excision may be impossible. In this case, as much of the bursa as possible should be excised, and the remaining portion should be curetted and treated with a cauterizing agent, such as phenol.

(*k*) *Bunion.*—"A bunion is an inflamed adventitious bursa which is formed over the metatarsophalangeal joint of the hallux valgus" (McWilliams). A bunion may develop secondarily to, or coincidently with, hallux valgus. As will be described below, hallux valgus is the lateral deflection of the phalanges of the great toe caused by the wearing of too tight, too pointed, or too short shoes. The deflection results in a gibbus at the metatarsophalangeal joint, which is subjected to a continuous, abnormal amount of pressure. As a consequence, a lubricating sac or bursa will form in this situation. This bursa or bunion most frequently is inflamed and may be exquisitely sensitive.

The treatment of the acutely inflamed bunion consists of removal of pressure by rest in bed, or by wearing very large shoes, by hot fomentations and, in some cases, by the introduction of a rubber pad with flanges between the great and second toes. These pads resemble a small Brewer empyema tube. Their purpose is to correct the phalangeal deflection and minimize the prominence of the gibbus. The most successful type of treatment of bunion is operative. (For details see Hallux Valgus, p. 567.)

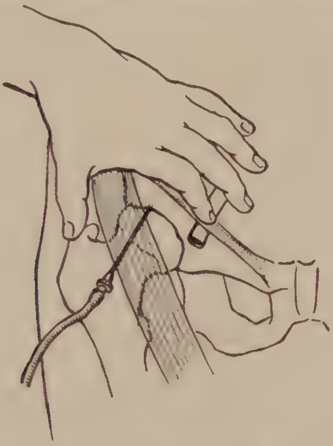

Fig. 366.—Aspiration of hip-joint from in front. Needle is inserted midway between the trochanter major and the intersection of the femoral artery with Poupart's ligament. (McWilliams, Clarence A., Lewis' Practice of Surgery, W. F. Prior Co., Inc., Publishers.)

11. **Sprains.**—*(a) Hip.*—Because of the depth of the acetabulum, the great strength of the ligaments of the hip-joint, and the overlying muscles, sprain of the hip-joint is extremely infrequent. The diagnosis is made by a history of trauma, the demonstration of pain under certain distinct motions of the hip. There may also be localized tenderness. The treatment is rest and application of external heat. Aspiration may be necessary (Fig. 366).

(b) Knee.—*Sprain of the knee* is a term which may be applied to wrenches of the knee-joint which cause microscopic injuries to the supporting ligaments, and capsule but no gross solution of their continuity.

Rupture of the lateral ligament of the knee is not a sprained knee, but a far more serious injury. The diagnosis of sprained knee is made by history of injury and by pain induced by certain motions of the knee. The knee is tested by grasping the lower extremity at the ankle and the knee. Holding the knee firmly fixed with the leg fully extended the ankle is pulled toward one side or the other to test for the presence or absence of pain at the knee margins. In case of severe rupture of the lateral ligaments of the knee abnormal lateral mobility of as much as 30 degrees may be present. The knee is further examined by the surgeon grasping the leg and patient holding the thigh flexed near the knee (Fig. 367). An attempt is then made to move the leg up and down without flexion or extension, a motion which is only possible with an injury to the crucial ligament. The knee is further tested with the knee flexed to right angles. The leg is then rotated from the ankle. Sir Robert Jones[1] has emphasized the importance of the elicitation of tenderness at certain points about the knee-joint in making the diagnosis of knee-joint injuries (Fig. 368). A further symptom of sprain of the knee is the presence of effusion of fluid into the knee-joint. Excessive fluid in the knee-joint is always first apparent proximal to the patella. A sense of fluctuation readily may be appreciated by using the usual three-point test. Two "watching" fingers are placed at the lateral margins of the convexity, and by means of it pressure is made which will cause the watching fingers to appreciate a fluid wave. A further test for effusion in the knee-joint is the demonstration of "floating patella." The patella is gently forced

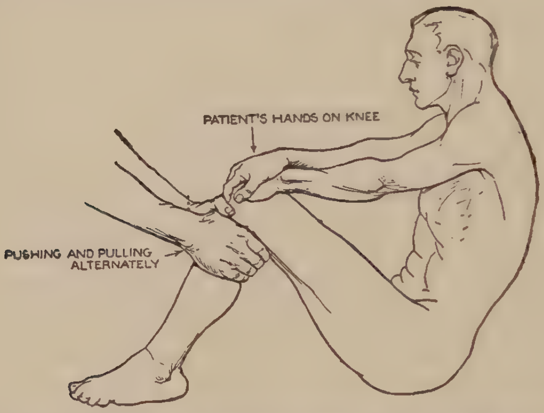

Fig. 367.—Method of determining acute rupture of the crucial ligaments of knee by pushing backward for anterior and forward for posterior crucial rupture. (From Forrester's Imperative Traumatic Surgery, published by Paul B. Hoeber, Inc.)

[1] Jones, Sir Robert: Injuries to Joints, 2d ed., Oxford University Press, p. 151.

downward upon the underlying bones, from which it normally is not separated and on contact with them gives rise to a characteristic click. This test shows that the patella has been forced outward by the excess fluid in the knee-joint.

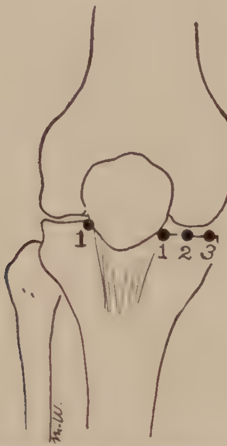

Fig. 368.—Points of tenderness about the knee-joint in certain injuries. Tenderness at point (*1*) on full passive extension, with swelling on each side of the ligamentum patellæ, suggests a tender postpatellar pad. Tenderness at point (*2*) suggests injury to the anterior portion of the internal semilunar cartilage. Point (*3*) is the usual point of tenderness in sprains of the internal lateral ligament. (Jones, Sir Robert, Injuries to Joints, 2d ed.)

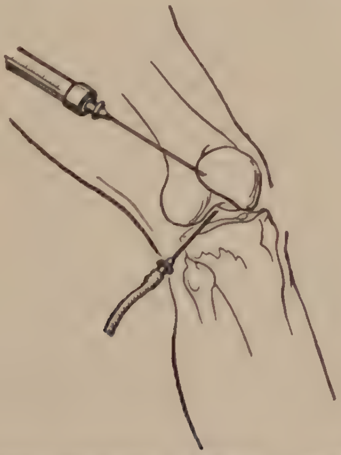

Fig. 369.—Antero-external aspiration of knee-joint. The needle is inserted 1 inch to the outer side of the patella. (McWilliams, Clarence A., Lewis' Practice of Surgery, W. F. Prior Co., Inc., Publishers.)

The treatment of sprain of the knee with "water on the knee" has been described previously. It includes rest, repeated aspirations (Fig. 369), and early motion. In the more severe cases where a partial rupture of the ligaments is suspected, immobilization in a plaster cast is indicated. The proper application of a *plaster cast to the lower extremity* requires a certain amount of skill for the successful treatment and the comfort of the patient. At least two assistants will be required. The patient lies flat upon his back and the foot is held up by an assistant or by suspension in a loop. The lower extremity is then enclosed in a single layer of smoothly applied stockinet from the dorsum of the foot to as high up in the groin as is possible. Owing to the difference in diameter of the thigh and the leg, it may be necessary to use two sizes of stockinet which may be carefully overlapped in the region of the knee. The extremity is next wrapped with one or more smoothly applied layers of sheet wadding which are thin layers of cotton so prepared that their surface is smooth and that they have various widths. The next and perhaps the most important step of all is the encircling of the malleoli with a properly prepared felt pad (Figs. 370, 371). This pad is so cut that projections of it rest upon the malleoli, leaving the tendo achillis and the anterior extensor tendons entirely free. It is neatly sewed together at the anterior side. All the edges of the pad are beveled. Next a circular pad is placed over the patella. In the center of this pad radial incisions are made so as to make numerous pointed tongues which, together with the circumference of the pad, are beveled. The wet plaster bandages are now applied. These are wound around the extremity very smoothly and with sufficient tension to have them snug but not tight. As each

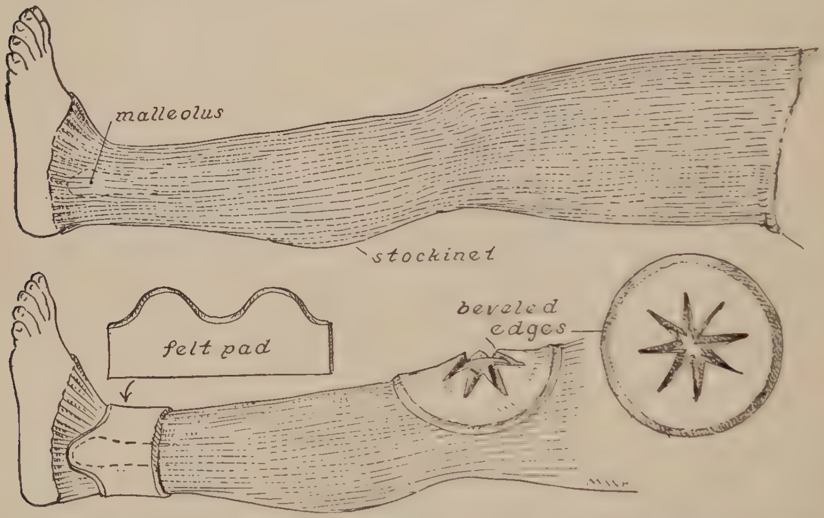

Fig. 370.—Application of leg cast. Stockinet smoothly applied to entire extremity. Felt pads for knee and malleoli.

succeeding layer of plaster bandage is applied it is thoroughly rubbed by an assistant so as to insure the intimate distribution of the plaster Paris within the meshes of the gauze. Failure to observe this precaution is likely to produce a cast which is weak and which splits apart in layers because of the non-adherence between the individual layers of bandage. Any parts of the bandage which may not become sufficiently moistened should be sprinkled with water before they are rubbed. The thickness of the plaster cast is variable. In young active children where the cast will be subjected to considerable violence, *at least* ¼ inch will be required. In older and more sedentary individuals the cast may be somewhat thinner. When the proper thickness of plaster has been reached, the stockinet at the top of the cast is turned down, and is fastened by an

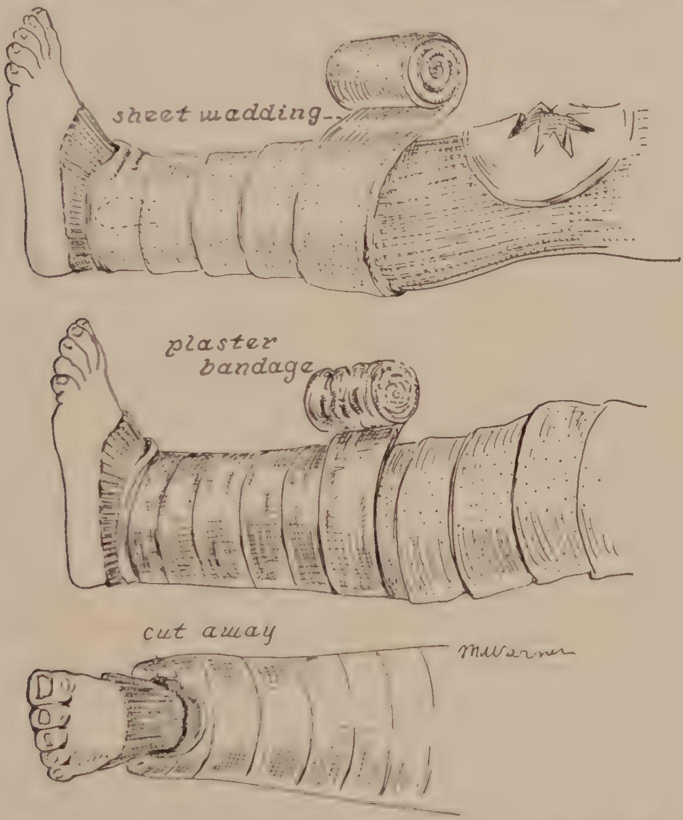

Fig. 371.—Cotton sheet wadding applied over stockinet and felt pads. Some prefer to place the felt pads outside of the sheet wadding. The plaster-of-Paris bandage is applied over the sheet wadding, taking care that it is smoothly applied and continuously rubbed during the application. The cast is cut away in front and in back to allow flexion and extension of the foot.

extra turn of plaster bandage, thus insuring a smooth, rounded top of cast. An arched piece is now cut out from the anterior and posterior aspects of the lower aspects of the cast (Fig. 371). This is done in order to avoid interference with flexion and extension of the foot. The final revision of the lower end of the cast will be deferred until the second day when the plaster will be entirely dry. The stockinet is then turned upward and made fast to the cast by strips of 1-inch adhesive plaster.

In a cast which has been properly constructed, the weight will rest upon the malleoli without pain because of the felt pads, and walking may be painlessly accomplished because of the freedom of motion at the front and back of the cast. Should blisters form either over the tendo achillis or anteriorly the incisures in the cast should carefully be deepened with a cast knife until the trouble is remedied. Properly applied, a cast to the lower extremity should permit little if any motion at the knee-joint.

(*c*) *Ankle.—Sprains of the ankle* are of very common occurrence. They occur as a consequence of a violent "turning" of the ankle. The ligaments are overstretched and some of the fibers are ruptured. By far the most common variety of sprain of the ankle is that which follows violent inversion of the foot. Here the ligaments most commonly injured are the anterior and middle fasciculi of the anterior lateral ligament (ligamentum talo fibulari anterioris and ligamentum calcaneo fibulari). Uncommonly the foot may violently be everted when the internal ligament and the anterior and posterior tibiotarsal ligaments (ligamentum deltoideum) are involved. The symptoms of sprain of the ankle are instant intense pain and a very rapid effusion of fluid in the neighborhood of the injury. A swelling the size of a hen's egg may appear in five or ten minutes. The pain occasionally is so severe as to cause the patient to faint. Weight-bearing may be impossible. In all cases of sprains of the ankle the possibility of fracture should be suspected and, unless it can be excluded clinically, the ankle should be examined by *x*-ray. The fibula should be carefully palpated for tender areas, particularly in its lower 2 inches. A tender point upon the fibula should arouse suspicion of Pott's fracture and *x*-ray should be made. Tenderness and swelling about the ankle-joint are present in fracture of the astragalus and if there is any question *x*-ray should be made. In examination of an ankle for sprain it will be noted that all motions which place the injured ligament upon a strain are extremely painful. In injuries to the external lateral ligament a diagnostic point is that inversion of the foot is painful. Similarly, in injuries of the internal lateral ligament, eversion of the foot is painful.

The usual first-aid treatment is the application of cold compresses to reduce the swelling. It is possible that further study of this subject will demonstrate that hot fomentations, or hot foot-baths, which are most acceptable to the patient, are of equal if not superior value. The congestion induced by the external heat is quite likely to facilitate the dissemination of the adventitious effusion. A treatment which is recommended by many and which has proved to be of considerable value in the hands of the writer is the employment of contrast foot-baths. Here the foot is first immersed in warm water for a period of five minutes, and is then plunged into cool or cold water for thirty seconds or one minute, and then is returned to the hot water. This procedure is continued until relief is obtained, as long as an hour or more occasionally being necessary. The administration of codeine or morphine may be necessary for the pain. Aspirin certainly has a beneficial influence in the mild cases. Older writers advocated the use of lead water and laudanum, tincture of arnica, and ammonium chloride solution as applications. DaCosta believes that the virtue of these evaporative solutions comes from the cold which they produce. Bandaging for the purpose of control of swelling generally is not only futile, but causes the patient a great deal of unnecessary pain. Of prime importance is the placing of the injured extremity at rest. Rest in bed is preferable, but the employment of crutches is indicated in patients who must be up and about. After twenty-four hours, when the swelling has begun to subside, supportive measures are indicated. The adhesive strapping in the method devised by Gibney is extremely useful (Fig. 372). The foot is held in its

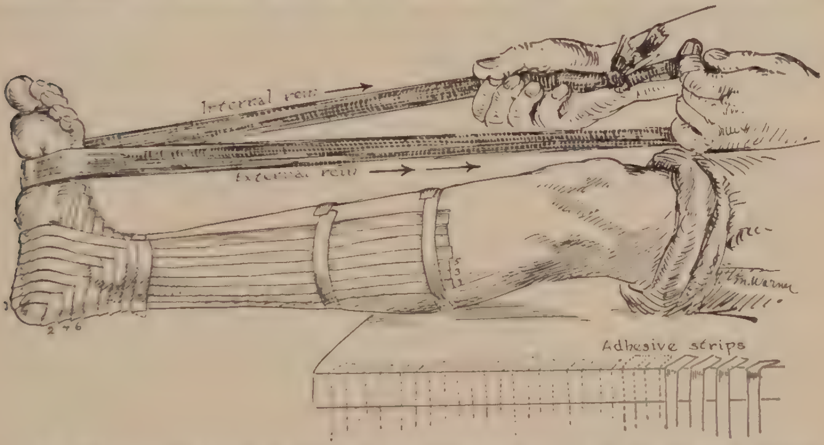

Fig. 372.—Gibney adhesive strapping for sprained ankle. For sprains of the external lateral ligament stronger traction is made upon the external rein to secure eversion of the foot. For sprains of the internal lateral ligament the opposite procedure is followed.

optimum position by either an assistant or by the patient himself holding bandage "reins" (Fig. 372). It is important that the strapping be put on with the foot held in dorsal flexion. If the external lateral ligaments be involved the ankle should be strapped in a position of eversion, so as to relax the strain upon the affected ligament. If the internal lateral ligament be involved the foot is strapped in a position of inversion. The alternate longitudinal and transverse strips of adhesive, $\frac{1}{2}$ inch wide, are woven about the ankle-joint in the manner pictured in the illustration. Theoretically, these strips should not cross the ankle anteriorly in the midline because of the consequent interference with the circulation. Practically, however, an occasional short overlap does not seem to interfere with the efficacy of the strapping. Should swelling of the foot occur following the strapping, the adhesive "cast" may be cut longitudinally on the dorsum for its entire extent. Hutchins[1] has contributed the following method of the care of sprained ankles which he says has been approved by an experience of twenty-three years: "The patient is seated upon the table at such level that his depending foot hangs 6 to 8 inches lower than the knee of the operator, who sits facing him. With adhesive strips $1\frac{1}{2}$ inches wide cut in proper length, the patient's foot is placed upon the operator's knee so that the ankle is dorsally flexed to 80 to 85 degrees from the long axis of the tibia and rests the full weight of the extremity upon the head of the fifth metatarsal. The patient's leg must be wholly passive. This leaves the leg in straight alignment from the hip- to ankle-joints and throws the foot into slight eversion. The first strap runs spirally around the lower calf on the medial side, across the instep and cuboid, under the sole, falling into a natural sweep on the dorsum. This is the salient control of the hypermobility. The second strap is a counterpart in the opposite direction, acting to limit eversion and balancing the first. The third support is a stirrup from the middle of the calf and passes in the lateral place of the ankle-joint. The fourth and narrow strip retains the third support in contact with the leg at its isthmus above the malleoli. It is imperative that the patient's leg be maintained in the same posture throughout the dressing and his muscle action inhibited. Walking is instituted at once with the foot carried in the fore positions, straight ahead."

Another useful method of treating mild sprains of the ankle is the employment of a properly fitting elastic anklet which is to be used when the patient is up and about. The contrast baths may now be instituted, a procedure which is not possible with the adhesive plaster strapping.

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[1] Hutchins, Charles P.: Boston Med. and Surg. Jour., 197, 91, July 21, 1927.

A further very useful procedure which was suggested to the writer by Dr. George Musselman, but for which he claims no originality, is the use of the valgus and varus pads. These are tapering edge, curved felt pads, about 3 inches long at the outer border, which are placed inside of the shoe so as to lift up the injured side of the foot, and relax the extension on the overstrained ligament on that side. The pads are glued into the shoe[1] (Fig. 373). It is remarkable to see the often almost instantaneous relief obtained by this treatment. Almost incapacitated patients not infrequently may walk without pain after the pads have been placed in the shoe. Some surgeons advance very favorable claims for the use of diathermy immediately following the accident. A pressure pad at the site of the sprain may be of use.

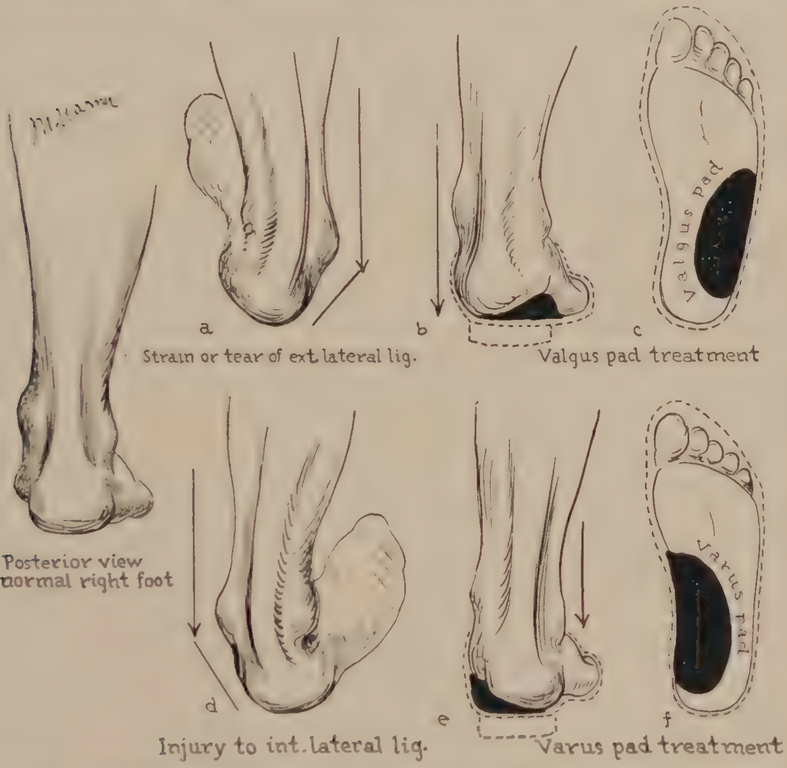
a
b
c
Strain or tear of ext. lateral lig.
Valgus pad treatment
Valgus pad
Posterior view normal right foot
d
e
f
Injury to int. lateral lig.
Varus pad treatment
Varus pad

Fig. 373.—Treatment of sprained ankle by means of felt pads glued inside the shoe. The pad relaxes the strained ligament.

Skilful massage is a useful adjunct to the treatment of sprained ankle. Proper amount of rest is indicated. The patient should not be permitted to walk enough, or to use such motions, as will cause pain. An overused or prematurely used sprained ankle has a tendency toward chronicity and it will save time of morbidity to make the initial treatment thorough.

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[1] For this purpose "Griswold's Family Salve" is useful. It is heated as sealing wax and applied to the pad. Sealing wax may also be used.

(*d*) *Toes.*—Sprains of toes are relatively uncommon and occur chiefly as the consequence of blows upon the ends of outstretched toes. Most of those cases will require *x*-ray examination for the elimination of fracture. Simple sprains yield promptly to rest and external heat.

12. **Acute Traumatic Tenosynovitis.**—This condition comes about from overuse and overstrain of the extremity. A low-grade, non-bacterial inflammation occurs within the tendon sheath. The treatment is rest, heat, and strapping or some other form of immobilization of the extremity.

13. **Acute Traumatic Synovitis of the Hip-joint.**—Overuse and slight traumata of the hip-joint, particularly in children, may bring about a condition of traumatic synovitis of the hip-joint. The patient's mother will notice that the child is limping and will consult the doctor to find out what is wrong with the child's foot, ankle, or knee. A very common complaint is pain in the knee, an ill-advised treatment of the knee is not infrequently carried out. In all cases of pain in the knee the hip should be examined as well as the knee. The child to be examined should be stripped and requested to lie down upon the examining table. In those individuals who are suffering from an acute synovitis of the hip-joint it will be noticed that they lie upon the table generally with the affected thigh drawn up. When asked to straighten the leg upon the table, they do so reluctantly and slowly, if at all. With the patient lying flat upon his back, and the surgeon fixing the pelvis by making firm pressure upon the anterior superior spine of the ilium on the opposite side, a gentle attempt is made to widely abduct the affected thigh. In practically all unaffected hip-joints the thigh may generally easily be made to lie flat upon the table at right angles to the body axis. In cases where the hip-joint is affected the protective spasm of the thigh muscles will prevent more than a slight abduction, and efforts to increase it will occasion pain.

The ordinary cases of this condition will generally respond promptly to mere rest in bed for a week or ten days. An *x*-ray examination will usually be made. In the more severe cases it will be necessary to apply adhesive traction to the leg with 3 or 4 pounds of weight and elevate the foot of the bed for countertraction. The condition may resemble synovial tuberculous disease. In the latter condition, however, the symptoms will not subside after the simple treatment of a week or ten days' rest in bed. The prognosis in most of these cases is excellent, but, according to Fraser,[1] three points should be kept in mind:

"1. That a joint once the subject of traumatic arthritis is apt to suffer again if any injury is sustained;

"2. That a simple traumatic arthritis may be the predisposing factor in localizing a subsequent infective disease of the joint; and

"3. That a traumatic arthritis, accompanied by long-standing intra-articular effusion, may result in permanent weakening of the joint from stretching of the ligaments."

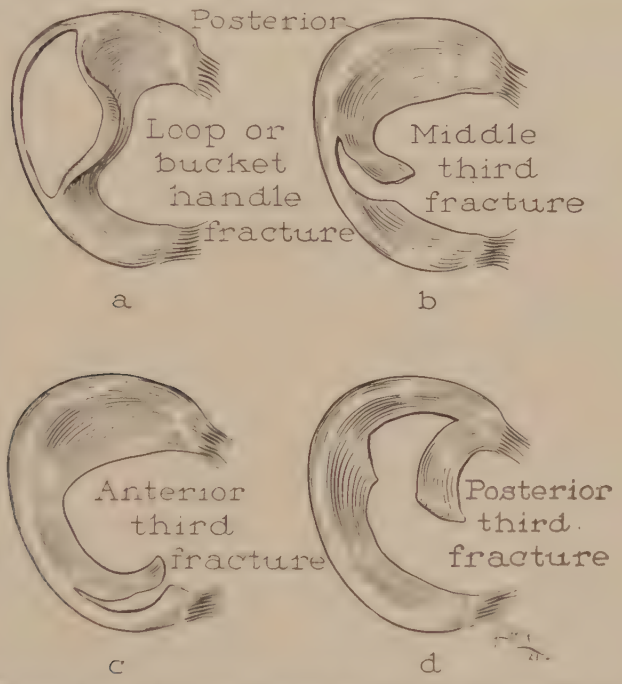

Fig. 374.—Common types of fracture of internal semilunar cartilage. (Henderson, M. S., Surgical Clinics of North America, December, 1927.)

Fraser advises immobilization of the extremity in a splint and the aspiration of the joint if the effusion or fluid becomes excessive. In the cases which have recurring attacks and develop into a chronic synovitis, counterirritation of the skin by blisters or the cautery may be employed. In obstinate cases a mechanical appliance which will support the joint and limit its movements may be necessary.

14. **Acute Infective Synovitis and Arthritis.**—The treatment of this grave condition is a problem of major surgery.

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[1] Fraser, John: Surgery of Childhood, Wm. Wood & Company, New York, 1926, p. 364.

15. **Injuries to the Knee.**—In addition to sprains of the knee, which have been described above, several other injuries may be mentioned.

(*a*) *Injuries to the Semilunar Cartilages.*—The semilunar cartilages of the knee-joint are subject to all grades of injury, varying from minor fractures or traumatisms of one or both cartilages to severe fractures, or complete avulsion of the cartilage with dislocation. Of the fractures of the internal semilunar cartilage the "bucket handle" type is the most common[1] (Fig. 374). Injuries to the semilunar cartilage are most frequently caused by a forceful, adventitious twisting movement of the knee with the foot fixed. On the other hand, injury may follow the most trivial and ordinary movement. Timbrell Fisher[2] divides these injuries into two classes. In the first, the symptoms are severe from the beginning and recurrences usually tend to become more frequent, but are associated with less reaction. The patient experiences a sudden twist of the knee, experiences severe pain on the inner or outer side of the joint, and falls to the ground. In the great majority of these cases there is no interference with flexion but there is inability to extend the leg or joint by some 10 to 20 degrees. The joint locking may be momentary or absent. There is a rapid effusion of joint fluid, and attempts to extend the leg are painful. "On palpation, there is, as a rule, well-marked tenderness in the situation of the anterior end of the semilunar due to the tearing of the weak anterior attachments, and hemorrhagic effusion into the loose connective tissue separating it from the aponeurotic capsule. Tenderness is also frequently present over the inner border of the tibia to the inner side of the ligamentum patellæ." In the second class the symptoms are slight at first, but gradually become more marked until definite locking occurs. There may be history of recurrent joint effusions, followed by a sensation of weakness or attacks of "giving-way" of the knee before the true locking occurs. "There may be definite tenderness over the antero-internal border of the tibia, or over a semilunar cartilage. The best way to elicit the latter is to place the thumb over the interarticular interval a little to the side of the ligamentum patellæ when the knee is flexed. On pressing backwards the patient may not necessarily complain of pain. If the surgeon will then, keeping his thumb in the same position, slowly extend the leg, the anterior end of the cartilage will, towards the end of extension, come in contact with the thumb and the patient will experience pain" (Fisher). The internal semilunar cartilage is more frequently injured than the external.

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[1] Henderson, M. S.: Jour. Amer. Med. Assoc., 90, 1359, April 28, 1928.

[2] Fisher, A. G. Timbrell: Internal Derangements of the Knee-joint, The Macmillan Co., 1924, p. 38.

Fisher[1] says that every case of original displacement should be treated upon the following principles:

1. Accurate reduction by manipulation of any existing block to full extension. This should be performed as early as possible, and may, though generally does not, require the use of an anesthetic. "The patient should be supine on the bed or couch. In the case of the right knee, the practitioner stands upon the outer side, grasps the patient's right foot firmly, and with the left hand steadies the knee. The knee is fully flexed, whereby the grip of the femoral condyle upon the displacement of the cartilage is relaxed. The leg is then abducted as much as possible, thereby opening up the inner side of the joint. Next, the practitioner rotates the leg inwards and outwards, and at the same time exercises pressure upon the convexity of the semilunar or upon any visible external swelling. By this rotatory movement, the practitioner assists the return of the cartilage to its normal position. Next, while the leg is internally rotated, it is suddenly extended, and an audible 'snap' often reveals the fact that the displacement is reduced. In the case of the left knee the position of the hands is reversed" (Fisher). In recurrent cases the patient will often lie down upon the ground and flex the leg upon the thigh and shake the knee until the dislocation of the semilunar cartilage is reduced. The criterion of reduction is the ability of the patient to fully extend the leg without pain and to walk.

2. The retention of the joint in such a position and for such a period that repair of the damaged structures may occur if physiologically possible. A firm bandage should be applied over a cotton pad which is placed over the joint. This should be removed daily for massage. Active movements of the foot and toes should be carried out from the first, but no weight-bearing should be permitted for fourteen days. During this term the patient is best kept in bed. Gentle, active movements of the knee will be instituted on the tenth day. The patient will begin to walk cautiously, but with great care, avoiding any movements which will cause outward rotation of the leg upon the fixed thigh, or inward rotation of the thigh upon the fixed leg. The raising of the inner side of the sole of the shoe will be valuable in taking off strain from the internal lateral ligament (Fisher).

3. The prevention for several months of strain upon the newly formed reparative tissues.

4. The preservation during this treatment of the nutrition of the joint structures and of the tone of the muscles which act upon the joint.

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[1] Fisher, A. G. Timbrell: Internal Derangements of the Knee-joint, The Macmillan Co., 1924, p. 47.

The author is inclined to believe that many of these cases, especially those in which the intelligent co-operation of the patient cannot be depended upon, are best treated by immobilization in a plaster cast. It must be remembered, however, that a plaster cast will not prevent the occurrence of rotational strains at the knee, and weight-bearing should be shunned as in Fisher's method. The cast should be split after a week to permit daily massage, after which the two halves are replaced.[1]

Galeazzi[2] believes that the crucial ligaments and the semilunar cartilages form a functional unit, and that coexistent crucial ligament lesions with cartilage lesions are often unrecognized. Careful instructions for the diagnostic inflation of the knee-joint for purposes of x-ray examination are given by Bernstein and Arons.[3]

Mandl[4] operates upon cases with frequent recurrence and where conservative treatment has been futile. Only 34 of this author's cases were cured by conservative measures. A two months' trial was considered all that was permissible for the conservative treatment. Henderson[5] considers fractures or tears in the substance of the cartilage to be of more common occurrence than dislocations of the cartilage. In all cases where an original dislocation of a semilunar cartilage cannot be reduced, and in all recurrent cases an operative removal of the cartilage is indicated. In all cases of fracture of the cartilage producing symptoms, operative removal is indicated. This operation is a major surgical operation.

(*b*) *Slipping Patella.*—In this condition there is a dislocation, generally outward, of the patella. It is more common in females and there may be a hereditary relationship to the etiology. Henderson makes the following diagnostic test. Have the patient sit so that the heel of her leg can be conveniently placed on the operator's knee. Then gently push the patella outward a little and flex the knee. If a slipping patella is causing the trouble, the patient will usually say that the sensation felt is somewhat similar to that experienced when the giving away of the knee occurred and she will become quite apprehensive if pushing outward on the patella is persisted in. "The treatment for a slipping patella is essentially surgical, and the simple procedure of transferring the insertion of the patellar tendon to the inner side of the midline will prevent dislocation" (Henderson). This, of course, should be regarded as major surgery.

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[1] Christopher, Frederick: Jour. Bone and Joint Surg., 6, 918, 1924.

[2] Galeazzi, R.: Jour. Bone and Joint Surg., 9, 515, 1927.

[3] Bernstein, M. A., and Arons, R. A.: Radiology, 7, 500, December, 1926.

[4] Mandl, Felix: Wein. klin. Wchnschr., 40, 522, April 21, 1927.

[5] Henderson, M. S.: Ann. Surg., 87, 911, June, 1928.

(*c*) *Injuries to the Lateral Ligament of the Knee-joint.*—The lateral ligaments of the knee-joint may be injured by blows from either side when the foot is held in a fixed position. This trauma may occur when a football player is tackled about the one knee when running with the opposite leg off the ground. Most commonly the internal lateral ligament (ligamentum collaterale tibiale) is injured. In testing for injuries to the lateral ligaments the lower extremity is grasped at the knee and ankle; with the knee held fixed the ankle is moved sidewise. Ordinarily the knee-joint is rigid and will resist this motion, but in injuries to the lateral ligaments an abnormal motion, which generally is accompanied by pain, is readily apparent. According to Jones and Lovett,[1] "Injuries to the internal lateral ligament are more serious than to the external, for the latter is never complicated with a displacement of the meniscus." Too much importance cannot be laid upon the necessity of keeping ligaments at rest until tissues have consolidated. Rupture and stretching of the internal ligament is often the origin of cartilage displacements which may be traced to early passive and active movements. In cases where the injury to the lateral ligaments is such as to permit a lateral deviation of the leg of not more than 10 degrees, a cure may be effected by immobilization in a plaster cast, followed by physiotherapy. In severe ruptures of the lateral ligaments of the knee-joint major surgical repair will be necessary. It has recently been emphasized by Harbin[2] that in complete lacerations of the internal lateral ligament and capsular tears, early surgical correction is preferable to fixation and apparatus alone.

(*d*) *Injuries to the Crucial Ligaments.*—In violent traumatism of the knee-joint one or both of the crucial ligaments (ligamentum cruciatum anterius and posterius) may be injured. The diagnosis of injury to the crucial ligament is made by the ability to move the leg anteriorly and posteriorly upon the thigh at the knee-joint (Fig. 367). This very serious injury of the knee-joint will require major surgical treatment.

16. **Loose Bodies in the Knee-joint (Joint-mice; Rice Bodies; Corpus Oryzoideum).**—Loose bodies in the knee-joint may be of several types. In addition to the dislocation semilunar cartilage described above, the knee-joint may contain single or multiple free bodies. In 50 cases of movable bodies in the joints Schum[3] found that 48 presented evidence of previous trauma. Brezovnik,[4] who found a free joint body measuring 7.4 x 4.5 x 1.3 cm. in the knee-joint of a man forty-one years

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[1] Jones, Sir Robert, and Lovett, R. W.: William Wood & Co., 1923, p. 24.

[2] Harbin, M.: Surg., Gynec., and Obst., 1928, 47, 155.

[3] Schum, H.: Brun's Beiträge zur klinischen Chirurgie, 141, 111, 1927.

[4] Brezovnik, V.: Casop lek cesk, 1925, 64, 1465, 64, 1518.

of age who had injured the knee in a fall six and a half years previously, believed that the finding of articular cartilage bordered by osseous spongiosa in a free joint body may be regarded as an indication of the traumatic origin of the free body. Liger[1] believes that the chemical reaction is of importance in the causation of free bodies in the joints.

Rice bodies are small bodies in the joint cavity which may be very numerous in number. They may possibly arise from detached portions of synovial fringes. In the study of a case of tuberculosis with positive guinea-pig inoculations, Rogers[2] found that the rice bodies were composed of tuberculous material. They are first attached to the wall of a tuberculous cavity, and are formed from the center of a tubercle. The only manner in which these bodies may figure in the subject of minor surgery is when one or more of the large, single or multiple variety may be worked to the lateral ramifications of the joint capsule, and there may readily be palpated directly under the skin as a discrete nodule. In this case the offending loose body may very readily be removed under local anesthesia with, of course, antiseptic and aseptic precautions. Where the bodies have slipped back into the cavity of the joint their removal is a major surgical operation.

Extreme conservatism must be exercised in making the diagnosis of loose bodies in the knee-joint. The existence of crepitus and of some interference with joint motion is not sufficient to make this. The author has seen one case where the knee-joint was opened with a diagnosis of loose body only to find redundant, inflamed synovial fringe. Removal of this fringe, however, produced a cure. In another case where the existence of a loose body seemed almost certain, examination of the patient's urine revealed a large amount of indican. With proper measures to correct the intestinal stasis and with temporary immobilization of the knee-joint an apparently complete cure was effected (Magnuson).

17. **Myositis Ossificans.**—The deposition of bone in muscle is called myositis ossificans. Its cause is occasionally, but not always, traumatic. The surgical treatment has not been encouraging.

18. **Developmental Anomalies of the Patella.**—(*a*) *Larsen-Johansson Disease of the Patella.*—In this condition there is an accessory center of ossification at the lower pole of the patella, causing a potential mechanical weakness at the upper end of the ligamentum patellæ. Hawley and Griswold[3] report a case of Larsen-Johansson disease of the patella in a boy twelve years of age who complained of intermittent

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[1] Liger: 50 tag d. deutsche Gez. f. Chir., Berlin, 1926.

[2] Rogers, M. H.: Jour. Bone and Joint Surg., 9, 636, 1927.

[3] Hawley, G. W., and Griswold, A. S.: Surg., Gynec., and Obst., 1928, 47, 68.

pain and a limp, following a mild strain of the left knee. Physical examination revealed only tenderness confined to the lower margin of the patella. On x-ray examination a small accessory center of ossification was found in the lower pole of each patella, but this finding was most distinct in the right knee which had been free from symptoms. On the left side the x-ray showed also the characteristic beak-shaped tuberosity typical of Osgood-Schlatter disease. The treatment consisted in support of the left knee by adhesive plaster, and restriction of activity for one month. At the end of that time the knee appeared to be normal. Five months later the patient returned complaining of pain in both knees after playing football or riding a bicycle. Swelling and tenderness were found at the lower borders of both patellæ. On the left side a bony enlargement was apparent. x-Ray examination showed pear-shaped patellæ with well-marked knobs on the lower poles where fusion of the separate ossification centers to the main bone was well advanced. Under the same treatment as that given before the symptoms promptly subsided. Hawley and Griswold call attention to the following resemblances between this condition and Osgood-Schlatter disease: (1) In both conditions there is an anomalous bone formation. In Larsen-Johansson disease this is in the form of an accessory center of ossification, whereas in Osgood-Schlatter disease it is manifested by the beak-shaped tibial epiphysis. It suggests a mechanical weakness at the upper end of the ligamentum patellæ in the former condition, and a similar weakness at the lower end of this ligament in the latter condition. (2) The two lesions are the result of continued strain on the patellar ligament and are usually not associated with sudden trauma. (3) The clinical signs and symptoms, roentgen findings, course, prognosis, and indicated treatment are similar.

(*b*) *Developmental Anomalies Mistaken for Fracture.*—Adams and Leonard[1] have reported 3 cases of developmental anomaly of the patella in which a diagnosis of fracture was made. In the cases reported in the literature, and in these authors' cases, the anomaly was constant in its x-ray appearance. The portion of the patella involved is always the outer and upper quadrant. This may consist of one or two separate fragments. The general contour of the patella is not distorted. The borders of the fragment are of cortical bone and its body of the same structure as the patella. Between the fragments there is a definite space. In the great majority of cases the anomaly is bilateral. A similar anomaly has been found in one of the sesamoid bones, beneath the head of the first metatarsal. In the differential diagnosis between the anomaly described and fracture the difference in the outline of the fragments must be borne in mind. In the anomaly the outline is smooth and is formed, as stated, by cortical bone, while in a fracture the edge is serrated. Fractures seldom occur in the upper and outer quadrant and have a different clinical history. The anomaly is usually bilateral, while fracture is more commonly unilateral. The differential diagnosis may be made from a roentgenogram. Adams and Leonard conclude that anomalies of the patella are more common than is generally supposed. Of a series of 63 cases diagnosed as fractures of the patella in the course of a year, 3 per cent. were found to be cases of congenital anomaly.

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[1] Adams, J. D., and Leonard, R. D.: Surg., Gynec., and Obst., 1925, 41, 601.

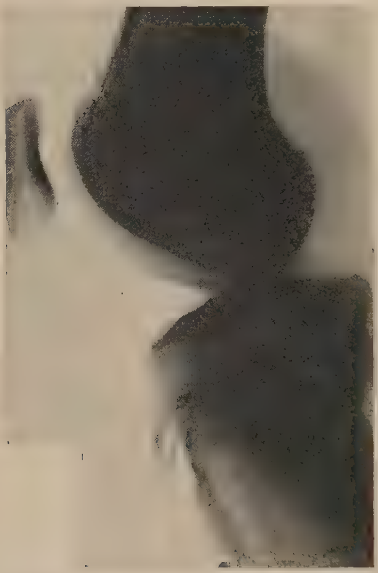

Fig. 375.—Osgood-Schlatter disease.

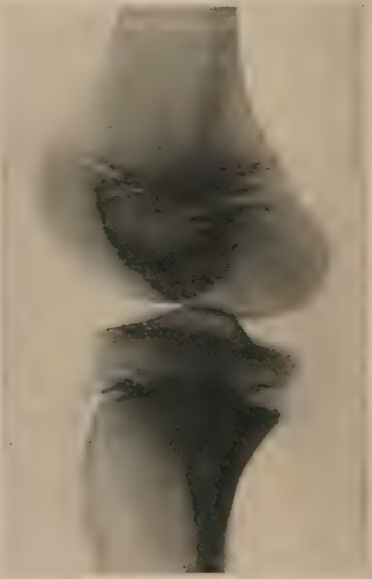

Fig. 376.—Osgood-Schlatter disease.

19. Partial Separation of the Tubercle of the Tibia; Osgood-Schlatter Disease; Apophysitis.—In this condition, which was described by Osgood[1] in 1903 and by Schlatter[2] in 1908, there is a partial separation of the tibial tubercle which may be due to trauma, sudden muscular effort, or long-continued exercise of the quadriceps. According to Vigholt,[3] none of the numerous and divergent theories which have been put forth to explain the pathogenesis have satisfactorily solved the problem. The symptoms may come on suddenly or develop slowly. There is local pain over the tibial tubercle, swelling, difficulty, or inability to extend the leg. Limping may be present. The x-ray appearance may or may not be characteristic, and both knees should be examined roentgenologically. The typical x-ray appearance is shown in Figs. 375 and 376. The condition occurs from the ages of ten to fifteen years and chiefly in boys. The symptoms may be very severe so as to give rise to the suspicion of osteomyelitis. In the differential diagnosis tuberculosis, bone cyst, and pretibial bursitis must also be considered. The treatment consists in relative or complete immobilization of the knee-joint. The author prefers a well-fitting plaster cast put on as described on page 512. The cast should be worn for six weeks, and after that violent exercise should be prohibited for a period of some two to four months. Ollerenshaw[1] advises absolute immobilization for six weeks in a well-fitting circular plaster cast which extends from the ankle to the groin and is well molded to the leg about the knee. Walking may be permitted while the cast is worn. After its removal Ollerenshaw advises massage and walking for six weeks with the use of a knee cage with a stop at 45 degrees flexion. Jones and Lovett say 30 degrees. The author has used the adjustable knee flexion leg brace in the case of

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[1] Osgood, R. B.: Boston Med. and Surg. Jour., Jan. 29, 1903, quoted by Jones and Lovett.

[2] Schlatter, K.: Beitr. z. klin. Chir., 1908, 59, quoted by Jones and Lovett.

[3] Vigholt, W.: Hospitalstidende, 70, 247, March 17, 1927.

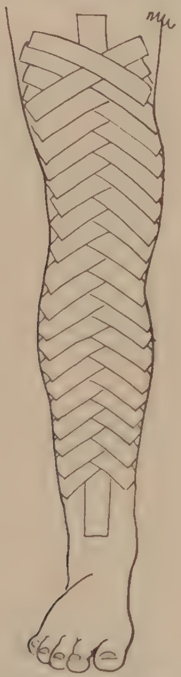

Fig. 377.—Treatment of Osgood-Schlatter disease by adhesive strapping.

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[1] Ollerenshaw, R.: Brit. Med. Jour., 1925, p. 944.

an active boy, who, after his immobilization in plaster of Paris, went to a ranch in the western United States and indulged in very active and continuous horseback riding. The result was a complete cure. Jones and Lovett[1] recommend a back splint strapped to the leg with adhesive plaster avoiding the tender area. Osgood believes that adhesive strapping is generally sufficient to cure this ailment without the use of plaster of Paris. The writer has cured a bilateral case by adhesive strapping applied as shown in Figure 377. Grossman[2] recommends criss-cross strapping with adhesive. The subjective symptoms are more reliable than the x-ray appearance in an estimation of the recovery.

20. **Fabella.**—The fabella is a sesamoid bone occasionally found in the head of the gastrocnemius muscle. Vogel[3] reports a case of double fabella. One should be on guard for the occurrence of a fabella in the interpretation of x-rays of the knee region where it may cause confusion.

21. **Dislocations of the Lower Extremity.**—Dislocations are far less frequent in the lower extremity than in the upper, the proportion being as about one to fifteen. Stimson found more dislocations of the hip than of any other joint, not excluding the phalanges. The latter, however, rank second in frequency and the semilunar cartilages, knee, and patella, third, fourth, and fifth respectively. Because of the great strength of the ligaments about the hip-joint extreme violence is necessary for dislocation.

(*a*) *Hip-joint.*—Four forms of hip-joint dislocations are usually described (DaCosta): (1) Upward and backward on the dorsum of the ileum; (2) backward to the border of the sciatic notch; (3) downward into the obturator foramen; (4) inward on to the pubes. Oscar H. Allis suggests the following classification:

Low thyroid Midthyroid High thyroid	All present abduction and outward rotation.

Reversed thyroid:

Low dorsal Middorsal High dorsal	All present adduction and inward rotation.

x-Ray examination should be made in all cases of suspected dislocation of the hip, because the dislocation may be accompanied by a fracture of the head.[4] The reduction of a dislocated hip is a major surgical procedure. It should not be attempted without a thorough study of the type of dislocation, and the possible relationship of the rent in the capsule and of the position of the head of the femur to the Y-ligament. Reduction may only be attempted under complete general anesthesia and often is very difficult.

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[1] Jones and Lovett: Orthopedic Surgery, William Wood & Co., 1923, p. 39.

[2] Grossman, J.: Med. Jour. and Rec., 1925, 121, 534.

[3] Vogel, K.: Zentralbl. f. Chir., 54, 2566, 1927.

[4] Christopher, Frederick: Arch. Surg., 12, 1049, May, 1926.

(b) *Knee-joint.*—Dislocation of the knee is extremely rare, and requires marked violence for its cause. Four forms are usually described—forward, backward, outward, and inward. Reduction generally is readily accomplished under general anesthesia. A dislocation of the knee-joint which remains unreduced for a certain length of time will cause pressure on the popliteal vessels and may give rise to gangrene of the extremity with the requiring of a subsequent amputation. Where there is extensive laceration of the ligaments of the knee-joint the suture of these ligaments, a major surgical operation, is indicated. Where extensive laceration of the ligaments of the knee-joint does not seem to be apparent, immobilization of the extremity in a plaster cast for four weeks is indicated. After this time gentle, active, and passive motion is indicated, together with the wearing of the hinged, cage brace of the knee-joint.

1. *Dislocation of the patella*, which is rare, may be either outward or inward. The diagnosis is readily made by the abnormal prominence of the patella at one side or the other and by the inability to flex the knee-joint. The dislocation generally may be reduced without much trouble under ether, although, according to DaCosta, incision is sometimes necessary. The instructions of Speed[1] are "flex the thigh on the body to relax the quadriceps; fully extend the knee to relax the patellar tendon, and to allow the patella to take its position as high up on the condyles as possible; manipulate the patella by pushing it inward to make it ride over the edge of the condyle; grasping the front of the thigh firmly in the hand to aid relaxation, push down the quadriceps. The leg is then flexed and the patella assumes a normal position." The knee-joint is immobilized for three weeks, after which careful active, and passive motion is instituted. A properly fitted brace which prevents inversion of the knee and eversion of the foot will be useful in the aftercare if there is any tendency to recurrence. It is probable that the various major surgical operations for the repair of the dislocation of the patella and its accompanying capsular injury will give a better functional result than conservative non-operative treatment.

2. *Dislocation of the semilunar cartilage* has been described above.

3. *Dislocation of the Head of the Fibula.*—Dislocation of the fibula

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[1] Speed, Kellogg: Fractures and Dislocations, Lea & Febiger, 1928, 2d ed., p. 766.

at the superior tibiofibular articulation rarely may occur. This injury may be very difficult to reduce and require open operation. Many cases, however, will respond to the manipulation of flexing the leg upon the thigh to remove the pull of the biceps and pushing the bone in place. The writer has seen one case which recovered when the patient moved the leg and started to walk upon it. The anterior tibial nerve (nervus peroneus communis) is in close relationship to the head of the fibula and care must be taken not to injure or put pressure upon it. After reduction the extremity should be immobilized in plaster of Paris with the leg partly flexed for four to six weeks (Speed).

(*c*) *Ankle-joint.*—Dislocations of the ankle-joint without fracture are extremely rare. With fractures of either external or internal malleoli, external or internal lateral dislocations of the astragalus upon the lower end of the tibia are extremely common. In case of fracture of the posterior malleolus of the tibia, posterior dislocation of the astragalus upon the tibia is common. Anterior dislocation is uncommon. The reduction of the dislocation is accomplished coincidently with the reduction of the fracture and often with but little difficulty. In cases of posterior dislocation with fracture of middle malleolus, section of the tendo achillis may be required (see below). All dislocations, and especially those about the ankle-joint, should be reduced immediately. The deformity of the dislocation may cause abnormal pressure on important arteries and bring about gangrene of the extremity distal to the jury unless reduction is promptly effected.

(*d*) *Subastragaloid Dislocations.*—In this condition there is a separation of the astragalus from the os calcis and the scaphoid. Reduction of this dislocation, which may often be difficult, will always require general anesthesia. After reduction, immobilization in a plaster cast for three or four weeks will be indicated.

(*e*) *Tarsal Dislocations.*—The writer has seen but one of these rare dislocations, which was readily reduced under ether. Reduction, however, could not be maintained without the application of pressure upon the adjacent bone sufficient to cause pressure necrosis. To avoid the later complication it was necessary to hold the dislocated part in position by traction and suspension by adhesive plaster upon the sole of the foot, so arranged as to pull the foot upward in dorsal position.

(*f*) *Metatarsal dislocations* are uncommon save for the subluxation which involves the fourth metatarsal (*Morton's disease, metatarsalgia*). In this condition there is pressure upon the subjacent sensory nerve, causing an extremely painful foot. Hertzler[1] contends that the nerve-pressure theory advanced by Morton to account for metatarsalgia has no facts to substantiate it, and that this condition is due to inflammation of one or all of the three sets of bursæ in the region of the metatarso-phalangeal articulation. He advises the obliteration of the bursæ by curettement. Jones[1] found that the sudden severe neuralgic pain characteristic of the condition was due to a compressing of the nerve twigs by the metatarsal heads, which had fallen out of their proper position in the transverse arch and nipped the nerves between the head of the metatarsal bone and the ground. According to this author, the symptoms are characteristic and definite. "The patient experiences a burning cramping pain in the front of the foot, generally under the fourth metatarsal head, often under the third, and, less commonly, under the second. The pain is sometimes preceded by a sensation of slipping. It occurs usually in walking, sometimes in standing, and very rarely in bed. The pain is very intense, and the patient almost immediately learns to relieve it by removing the boot, flexing the toes, and rubbing the front of the foot, and squeezing the metatarsals together, while other patients place the bare foot on a cold surface to obtain relief." The treatment may be difficult. Jones places a bar of leather across the foot under the tread well behind the head of the metatarsals. This method generally relieves but may not cure. An accurately made arched plate pressing into the hollow of the foot behind the heads of the metatarsals may give relief. The adjustable metatarsal pad of Milch[2] is simple and may be of service (Fig. 377a). A properly shaped and placed pad of wood, leather, or felt attached to the inside of the sole of the shoe is often very valuable. In severe cases resection of the heads of the metatarsals may be necessary.

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[1] Hertzler, A. E.: Jour. Missouri State Med. Assoc., 1926, 23, 368.

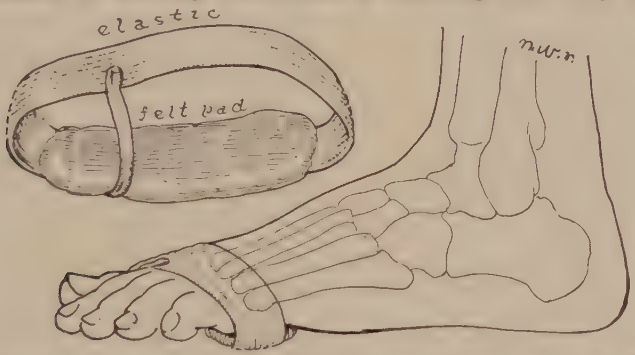

Fig. 377a.—Adjustable metatarsal pad. (Milch, Henry, Amer. Jour. Surg., December, 1927.)

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[1] Jones, Sir Robert: Med. Chir. Jour., Liverpool, 1892.

[2] Milch, H.: Amer. Jour. Surg., December, 1927, p. 594.

(*g*) *Dislocations of the Phalanges.*—The toes are not uncommonly dislocated by the blows upon their tips. Metatarsal phalangeal dislocation of the great toe may be caused by a fall upon the toe, by kicking, etc. According to Stimson,[1] "If the lateral displacement is wide, the flexor tendon may slip past the head of the metatarsal bone and make reduction impossible except by operation." Such an operation is best accomplished under general anesthesia and, of course, with strict attention to asepsis. Tenotomy of the extensor tendon, or the skidding it into place may be done. After tenotomy and after reduction of the dislocation the severed tendon may be united by suture. Of the phalangeal dislocations, that of the terminal phalanx of the great toe is the commonest. The dislocations are readily reduced by hyperextension and traction, generally without anesthesia. *x*-Ray examination must never be omitted because of the likelihood of coincidental fracture.

22. **Ruptures of the Tendon of Achilles.**—According to Brisset,[2] ruptures of the tendon of Achilles, while not common, are far from rare. In 2 cases seen by Brisset the rupture occurred while the patient was "pushing a barrel." In one case it occurred at the insertion, and in the other in the upper third, of the tendon. The latter case was of special interest because it had remained untreated for three months with the following effects: Marked inability to flex the foot; marked reduction of the force of flexion; and rapid fatigue which prevented the patient from working. At operation each fragment of the tendon was found drawn to a point, this making end-to-end suture difficult.

An excellent result was obtained by suturing the tendon and maintaining the foot in extreme flexion for several days.

When they are operated upon immediately, these ruptures are cured very easily.

23. **Minor Fractures of the Lower Extremity.**—There are many fractures of the lower extremity which properly may be included in the domain of minor surgery. The care of others, however, is a distinctly major surgical procedure, and will require all the skill and ingenuity possible.

(*a*) *Femur.*—1. *Impacted Fracture of the Neck of the Femur.*—Impacted fractures of the neck of the femur occur most commonly in the aged. A fall upon the great trochanter telescopes the neck of the femur into itself to a varying degree. Whereas complete fracture of the neck of the femur is a distinctly major surgical condition, the simplicity of the treatment of impacted fracture places it in the realm of minor surgery. In some cases, after a fall on the hip, the patient will merely have the symptoms of being unable to stand for a few days and, after that, of walking with a limp. The diagnosis is made certain by the *x*-ray.

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[1] Stimson, L. A.: Fractures and Dislocations, Lea & Febiger, 7th ed., 1912, p. 917.

[2] Brisset: Bull. et mém. Soc. nat. de Chir., 1927, 53, 982.

The cardinal principle of the treatment of this condition is the avoidance of the breaking up of the impaction. Violent manipulations, of course, are contraindicated. Weight-bearing should be prohibited for a period of six to eight weeks, because of the fact that premature weight-bearing may cause a breaking up of the impaction, or may cause a gradual shifting of the fragments with an angulation of the neck upon the shaft of the femur (coxa vara). Rest in bed without splints or

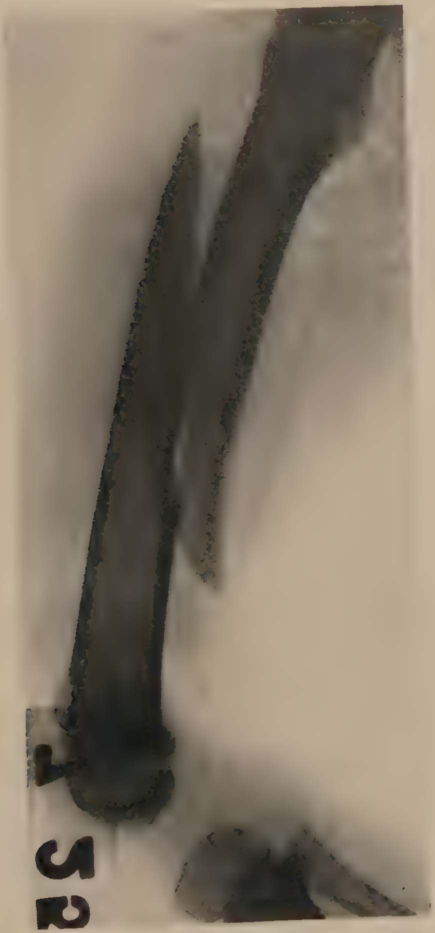

Fig. 378.—Fracture of femur. Treated by overhead traction.

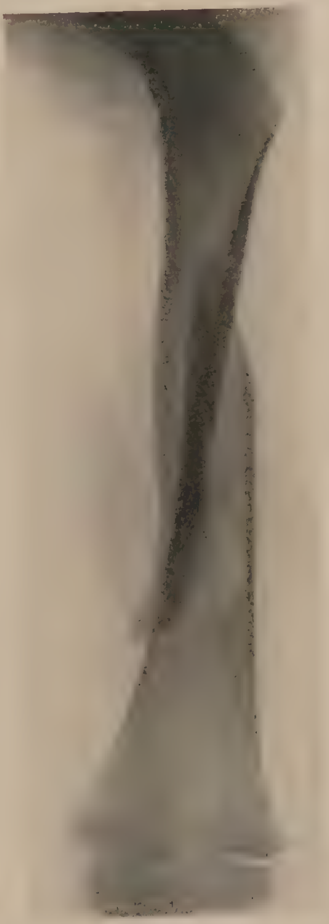

Fig. 379.—Anteroposterior view of fracture shown in Fig. 378.

casts is all that is required in this condition. Proper nursing care with particular attention to the prevention of decubitus is essential.

2. *Linear Fractures of the Neck of the Femur.*—Linear fractures or fissures of the neck of the femur may occur in adolescents. They may be easily overlooked without a careful inspection of the *x*-ray. The treatment is simple rest in bed for three to five weeks.

3. *Fractures of the Shaft of the Femur in Young Children.*—Fractures of the shaft of the femur in very young children and even those up to eight years of age (Figs. 378–380) are so easily and so successfully treated by the simple expedient of overhead traction that this condition is properly considered a minor surgical ailment (Fig. 381). Certain amount of skill and care is requisite to the proper application of the overhead traction. Two pieces of moleskin adhesive plaster or "Shiver's" plaster are prepared so that they will reach from the groin of the patient to a point 12 inches distal from the foot. An assistant holds the extremity suspended by the foot, while the moleskin adhesive is smoothly and carefully applied to the lateral surface of the leg. The plaster should be a little wider near the proximal end of the extremity than at the distal end. To avoid wrinkling, it may be necessary to make small darts or incisions at the borders of the adhesive in the region of the

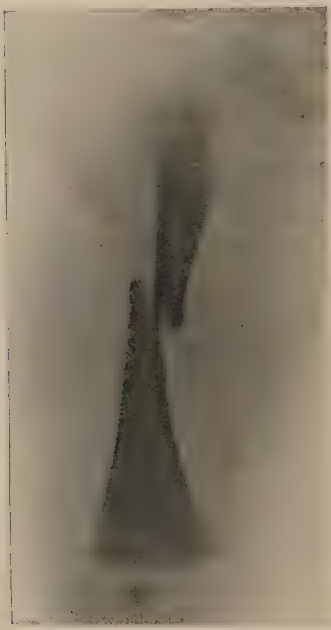

Fig. 380.—Birth fracture of femur.

knee-joint and the ankle. The adhesive is held in place by spiral strips of adhesive plaster, and by a snug but very smoothly applied gauze bandage. Because of the elasticity of the soft parts of the thigh, the proximal end of the adhesive may be 2 or 3 inches proximal to the upper end of the fracture. The lower ends of the moleskin adhesive are now folded over upon themselves so as to form a strap. These strap ends are wound over a wooden spreader and made fast by thumb tacks and by encircling bands of adhesive. It is extremely important that the spreader be of sufficient width, so that the lower ends of the moleskin adhesive plaster will not press upon the malleoli at the ankle, as pressure sores may result. It is also extremely important that the lower turns of bandage be not pressed too tightly upon the skin over the tendo achillis or pressure sores may result. A strong rope is now passed

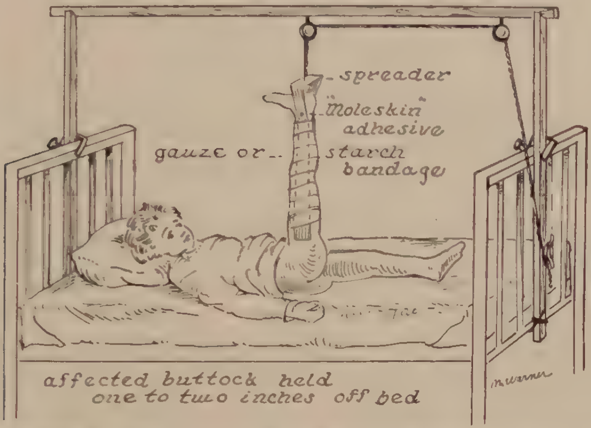

Fig. 381.—Treatment of fracture of the femur in children by overhead suspension. Fixed suspension is preferable to counterbalanced weights.

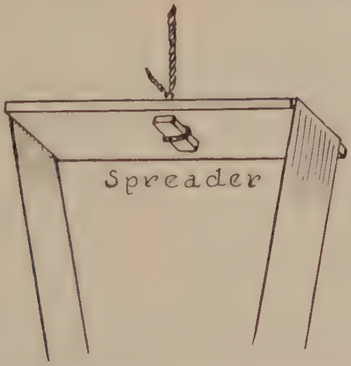

Fig. 382.—Type of spreader used in suspension of leg.

through the hole through the center of the spreader and knotted so that it will not slip through the hole when traction is made upon it. Strong cord may be used, in which event it is looped over a tongue depressor cross-piece under the spreader (Fig. 382). The distal rope is then passed through a pulley which has been suspended from an overhead Balkan frame. The rope is then carried to a second pulley at the foot of the bed, and is made fast to a cleat at the upright of the Balkan frame. The author prefers fixed traction in the case of young children to traction by counterbalancing weights. Sufficient traction is put upon this rope so that the child's buttock is at least $1\frac{1}{2}$ inch above the bed. This arrangement greatly facilitates the nursing care. Urination and defecation can be taken care of without disturbing the child's comfort.

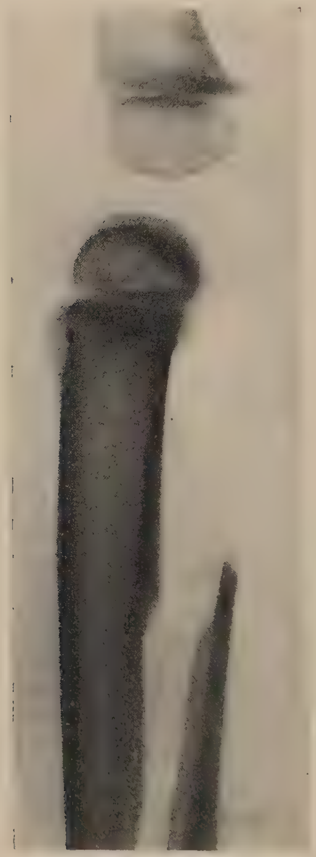

Fig. 383.—Fracture of femur in child.

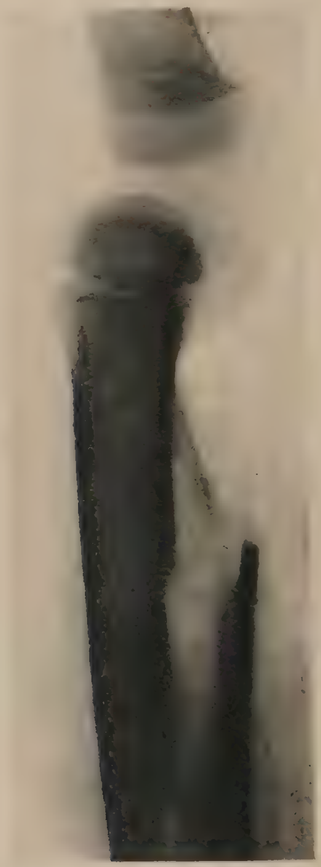

Fig. 384.—Same fracture as that shown in Fig. 383 to show manner of bridging of defect by callus.

The nurse, however, *must be warned* not to lift up the buttocks by placing her hand under them, under any circumstances, such as in the placing of a bed-pan. This procedure would not only cause the child great pain, but would disturb the alignment of the fragments. Should any elevation of the buttocks be required for any reason, it should be accomplished by lifting up the overhead traction. In the case of well-muscled children under eight years and those over eight years David[1] lowers the leg and uses overhead traction with the leg flexion, external rotation, and abduction. After about twenty-four to thirty-six hours the muscles of the thigh become relaxed and the fragments of the femur will come into excellent position. By means of portable x-rays this reduction of the fracture should be checked from time to time. Should more traction be required, the extremity on the affected side may be pulled still higher. In very young infants it is advantageous to suspend both legs, but where greater traction is required, it will be necessary to suspend one leg only. The extremity is kept in overhead traction for a period of six weeks on an average. At the end of this time, after checking the repair as well as possible by x-ray (Figs. 383, 384) the leg is lowered carefully to the bed. After a few days of skilful massage and active motion at the knee-joint the patient is equipped with a Thomas walking caliper splint. This is worn in the day time for six to eight weeks. After about the fourth week the adjustment of the caliper is changed every week so as to permit a slightly increasing amount of weight upon the fracture. David studied 75 cases of fractured femurs in children at the Cook County Hospital, Chicago, and found that where the fractured femur united with shortening, a compensatory overgrowth took place in these children. As time went on, the injured and shortened legs became longer and limping gradually ceased. Alignment of the fragments is more important than end-to-end apposition. Where the latter is not obtained, late x-rays show practically normal restitution of the shaft.

4. *Fracture of the Lesser Trochanter of the Femur.*—This fracture generally occurs in young people as a result of a powerful contraction of the psoas muscle which attaches to the lesser trochanter. The patient may remember a sudden painful snap while running. The pain is localized to the upper, inner aspect of the thigh, and is accentuated when the patient tries to stand erect or tries to flex the thighs, both of which motions put a stretch on the attachment of the psoas muscle. Walking may be possible but painful. There may be pain referred to the knee region and inability to cross the legs. The treatment of choice is that

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[1] David, V. C.: Arch. Surg., 1924, 9, 438.

recommended by Speed.[1] This "consists in placing the patient in a sitting position in bed, the limb being supported in an upright or slightly inverted position by sand-bags. Three or four weeks are required to eliminate the symptoms; the amount of time is gauged by the amount of pain when the leg is actively extended. To relieve the sitting posture, the patient may lie supine with the thigh flexed on the trunk held by pillows or splints."

5. *Minor Fractures of the Condyle and Epicondyle of the Femur.*—Fractures of the internal epicondyle of the femur, to which the adductor muscle and the internal head of the gastrocnemius muscle are attached, are of fairly common occurrence. The diagnosis is made by the localized tenderness and the *x*-ray. In the lesser cases, where a small fragment of bone is detached, the treatment will consist of rest in bed for ten days with a molded plaster-of-Paris splint or a cast, followed by restriction in exercise for a few weeks. Adhesive plaster strapping will cure some cases.

(*b*) *Patella.*—Chipping fractures of the patella or complete fractures of the patella without separation, or with slight separation of the fragments in elderly persons or those leading a sedentary life, belong to the domain of minor surgery. The diagnosis is made by the history of a fall on the patella, or of sudden pain in the knee following violent exercise (forcible contraction of the quadriceps femoris), by the localized pain, and tenderness, and by the *x*-ray examination. Early treatment with elevation, ice-bags, rest, and pressure elastic bandages. Scudder[2] says that sponge compresses may be used. "Two slightly moistened bath or carriage sponges are allowed to dry under pressure sufficient to flatten them. These are placed on each side of the knee and over it and are held by a few turns of roller bandage. Cool water is then poured over the whole. As the sponges absorb water, they enlarge, causing equable and firm pressure on the knee, thus very materially hindering the accumulation of fluid and favoring its absorption. These wet sponge compresses should be left in position for from twelve to twenty-four hours, and then a fresh set used." Aspiration of the knee-joint under strict aseptic precaution will accelerate removal of effusion. The treatment is the immobilization in a plaster cast for four weeks. A window should be cut in the cast over the site of the injury at the end of the first week. Through this window, which should be of ample size, gentle massage is carried out to improve the local circulation and to deter adhesions from forming between the patella and the underlying femur. At the end of this time the cast is cut in half, and daily heat, massage, and motion of the knee-joint are instituted. The cast is replaced after these treatments, and is worn for another two to four weeks, the patient getting around on crutches. Complete return of function may be expected in four to six months. Walking may be permitted in the chipping fractures as soon as the cast is applied. In the complete fractures without separation walking should be prohibited for three or four weeks.

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[1] Speed, Kellogg: Fractures and Dislocations, 2d ed., Lea & Febiger, 1928, p. 648.

[2] Scudder, C. L.: Treatment of Fractures, W. B. Saunders Company, 10th ed. 1927, p. 625.

Where there is marked separation of the fragments (Figs. 385, 386) and where there is no counter-indication such as diabetes, which has not been appropriately treated, advanced tuberculosis, cardiac and renal affection, or old age, open operation is the best treatment. Where, however, the conditions are not suitable for the carrying out of an open operation, a serviceable knee will be obtained in over half of the cases by non-operative means. The leg is put at rest and elevated. Absorption of the effusion in the vicinity of the knee-joint should be encouraged by cold and hot applications, and by massage. When nearly all of the fluid has been removed from the knee-joint, the leg will be completely extended on a "ham" or posterior molded plaster-of-Paris splint. The leg is elevated on an inclined plane to relax the quadriceps

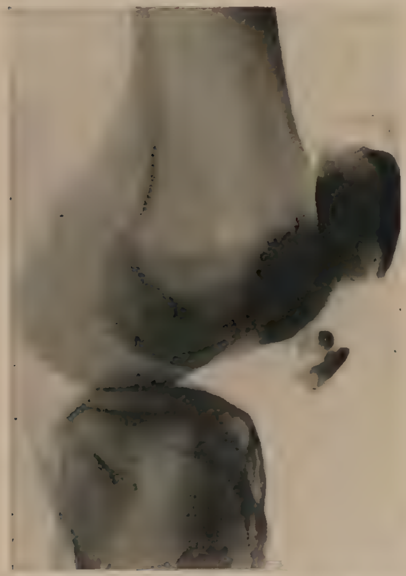

Fig. 385.—Fracture of the patella with separation of fragments.

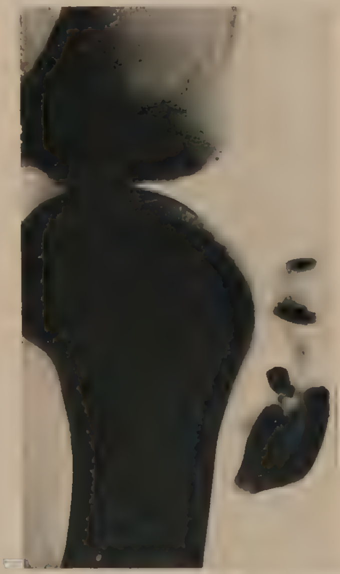

Fig. 386.—Fracture of the patella with separation and rotation of the fragments.

femoris muscle. Adhesive plaster straps are then obliquely crossed about the fragments so as to secure, as nearly as is possible, their approximation (Fig. 387). Scudder advises a third strap immediately over the broken edges of the fragments to hold them in apposition. This fixation is maintained for four to six weeks. The leg is fixed, on walking, for some six months, by a brace or plaster cast. A cane and snug knee bandage may be used for a month or two longer.

Manipulative surgery of the lower extremity should be mastered by every one who attempts to treat affections of the joints of that extremity.

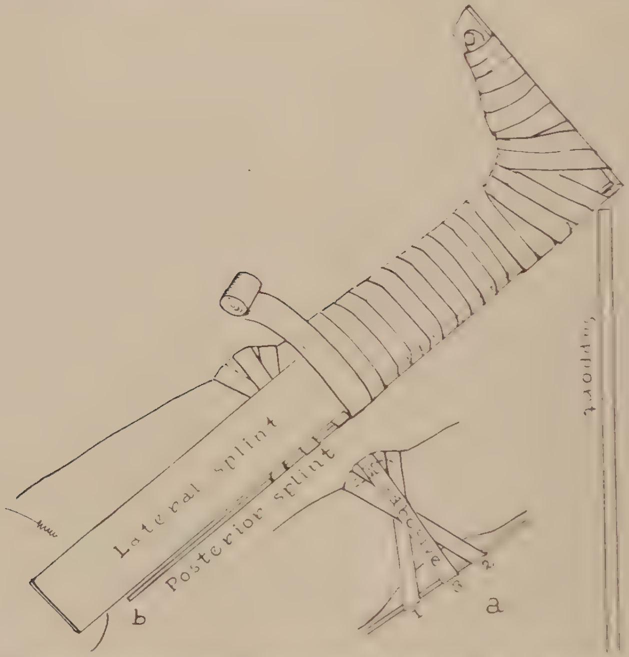

Fig. 387.—Non-operative treatment of fracture of the patella. (After Scudder.) *a*, Method of strapping patellar fragments. *b*, Application of splint.

The details of this type of treatment will fall beyond the scope of a work such as this book. For those who are interested, however, the writings of Fisher[1] are enthusiastically recommended.

(*c*) *Tibia.*—1. *Incomplete fractures of the shaft of the tibia* are, at any age, amenable to minor surgical measures. The leg is placed upon a pillow or upon sand-bags. Ice-bags, with due precaution not to have the ice-bag rest directly against the skin but with the interposition of a towel, are placed about the affected area until the maximum swelling has been reached and has started to subside. In many cases of fissures and linear fractures of the tibia the swelling will be so small that it will be possible to apply a cast at once. The small amount of sheet wadding inside the cast, and the elevation of the extremity on a pillow will take care of any slight swelling which may occur. At this time a circular plaster cast is applied from the tip of the toes to the groin. (Avoid pressure prominences and too great extensions in casts.) The method of applying this cast has been described previously. Care should be taken not to permit the cast to exert pressure upon the tip of the fifth metatarsal (Lisfranc's tubercle), because of the resultant pain and the likelihood of pressure sores. The leg will be kept in a cast for six weeks, during the latter part of which walking on crutches, but not weight-bearing, will be permitted. After removal of the cast, massage and active and passive motion will be instituted. The patient will still use the crutches, but will gradually bear an increasing amount of weight on the foot.

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[1] Fisher, A. G. Timbrell: Manipulative Surgery, The Macmillan Co., 1926.

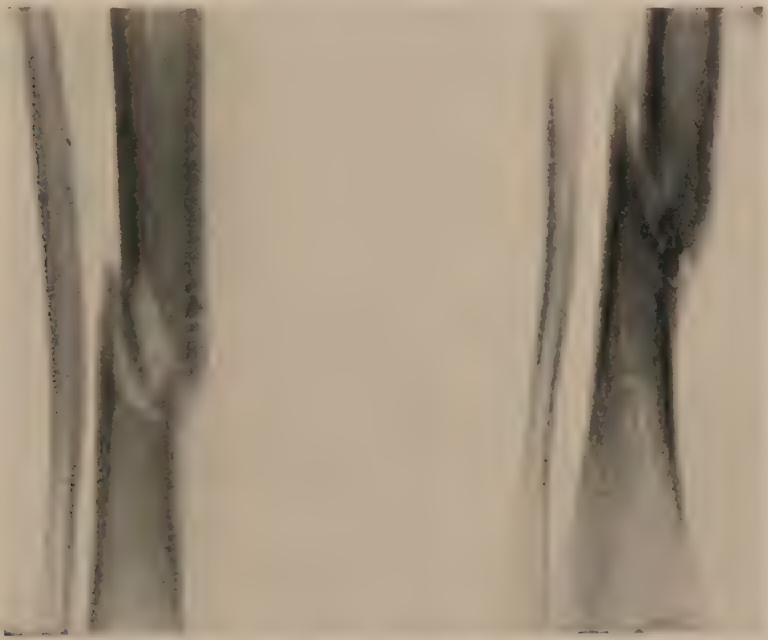

Fig. 388.—Fracture of the tibia showing manner of bridging of the defect by callus.

2. *Complete Fractures of the Tibia with Impact Periosteum.*—In these cases no reduction will be required other than the securing of the proper alignment, which is readily obtained by supporting the leg and exerting upon it a slight amount of traction. The treatment otherwise will be as outlined in the preceding paragraph. A warning should be made as to

the likelihood of "dishing" of the fracture when the leg is supported during the application of the plaster cast. This fault may be avoided by a moderate amount of supporting pressure on the fracture itself. A word of warning must be made in this latter maneuver, that sharp pressure be not made upon the wet plaster of Paris which, when dry, will cause painful projections on the inside of the cast.

3. *Isolated Fractures of the Internal Malleolus.*—The occurrence of isolated fractures of the internal malleolus is unusual without coincident fracture of the external malleolus (Fig. 389). In 100 cases of fracture of the ankle studied by MacKinnon[1] only 7 cases involving the internal malleolus alone were found. In cases of fracture of the internal malleolus the astragalus generally is dislocated mesially. This condition is treated by the application of a circular plaster cast after the maximum swelling has been reached and has started to subside. The foot is placed in a position of dorsal flexion and *eversion*. The cast will be split in halves after a week or ten days, and gentle, active motion, hot foot-baths, and skilful massage will be given three to five times weekly. The posterior half of the cast will be bandaged on after each treatment. Careful weight bearing will be started on or about the twenty-first day.

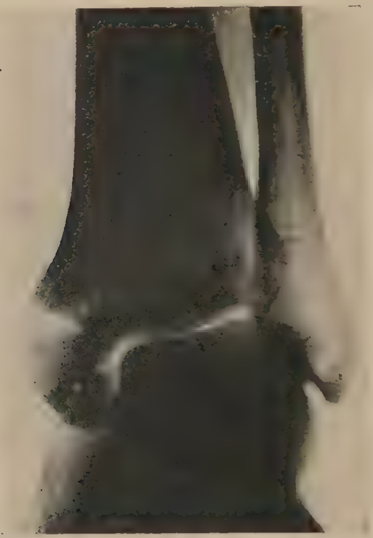

Fig. 389.—Fracture of the internal malleolus.

4. *Fractures of the Posterior Malleolus. Posterior Articular Margin of the Tibia.*—This fracture probably rarely occurs by itself, but

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[1] MacKinnon, A. P.: Jour. Bone and Joint Surgery, 1928, 10, 352.

rather as an accompaniment of fractures of the external malleolus and, less commonly, the internal malleolus. In MacKinnon's study of 100 ankle fractures there were 10 fractures of the posterior articular margin of the tibia. According to the author, the mechanism causing fracture of the posterior lip is usually a fall with the foot doubled under the body. The fragment is generally dislocated upward and there is a posterior dislocation of the astragalus upon the lower end of the tibia (Fig. 391). Because of the pull of the tendo achillis there is a great tendency of the dislocation to recur after reduction. This generally may be prevented by fixing the foot in extreme dorsal flexion and supination in a plaster cast, but occasionally the tendo achillis will have to be sectioned. This fracture will be immobilized in plaster of Paris at least three weeks before physiotherapy is begun.

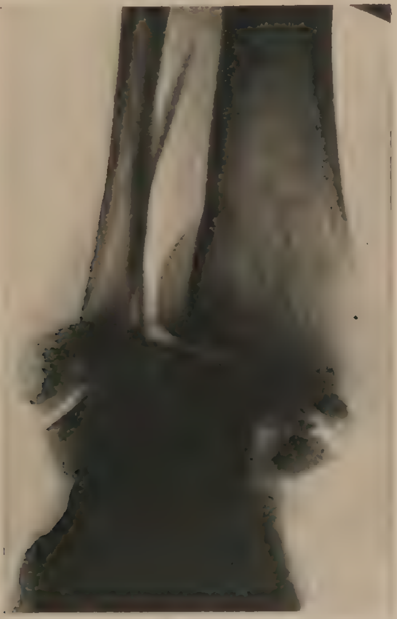

Fig. 390.—Severe Pott's fracture. Fracture of both internal and external malleoli.

(d) *Fibula.*—1. *Pott's Fracture.*—*Fractures of the lower end of the fibula*, the external malleolus, are extremely common and occur as the result of violent wrenches of the ankle, particularly those causing eversion. The diagnosis is readily suspected by the history of the traumatism, pain, and swelling about the ankle-joint, by the localized tenderness on the lower surface of the fibula, and by *x*-ray examination (Figs. 390–393). The point of local tenderness is on the side of the fibula at

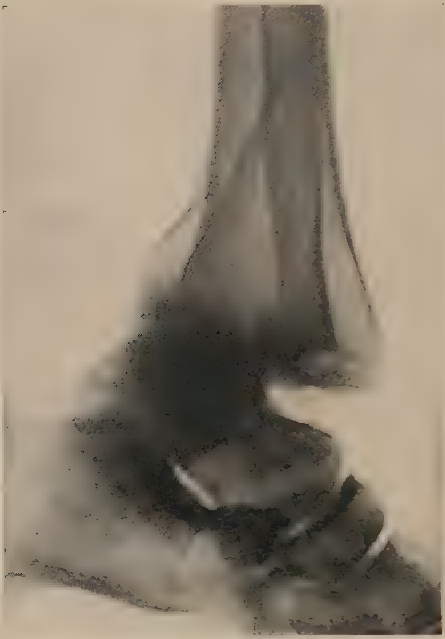

Fig. 391.—Lateral view of fracture shown in Fig. 390. Note posterior dislocation of the astragalus.

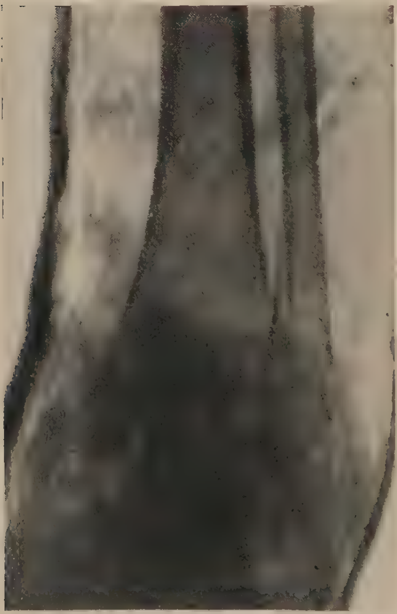

Fig. 392.—Anteroposterior view of fracture shown in Fig. 390 after reduction and incorporation in plaster cast.

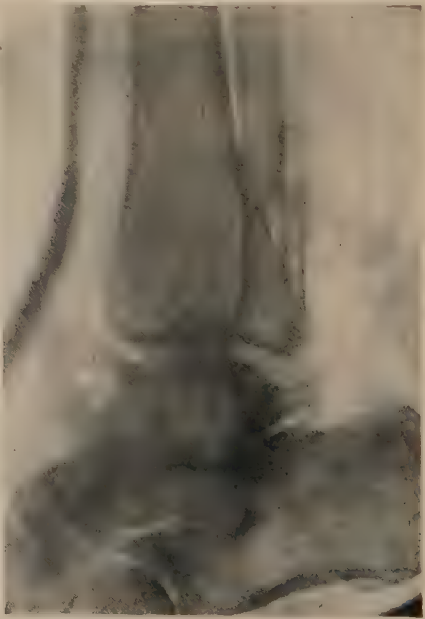

Fig. 393.—Lateral view of fracture shown in Fig. 391 after reduction and incorporation in plaster cast.

varying distances above the distal end, and in contradistinction to the points of tenderness in sprained ankle which are below or lateral to the tip of the fibula, or else directly on the tip of the fibula. The proper treatment of these injuries is rest in bed with ice-bags until the maximum swelling has been reached, and has started to subside. A circular plaster cast is then applied from the toes to the head of the tibia, taking care that the top of the cast is not so long as to interfere with flexion of the knee and that the bottom of the cast is not so long as to interfere with flexion of the toes. The foot is held in a position of dorsal flexion and inversion (supination). The position of dorsal flexion is essential in order that there be no temporary shortening of the tendo achillis during the period of immobilization, a fact which greatly delays walking. The position of inversion is of extreme importance. A fracture of the external malleolus causes a widening of the mortice of the ankle-joint with a lateral subluxation of the astragalus. By placing the foot in a position of inversion the fractured tip of the fibula is brought inward, and

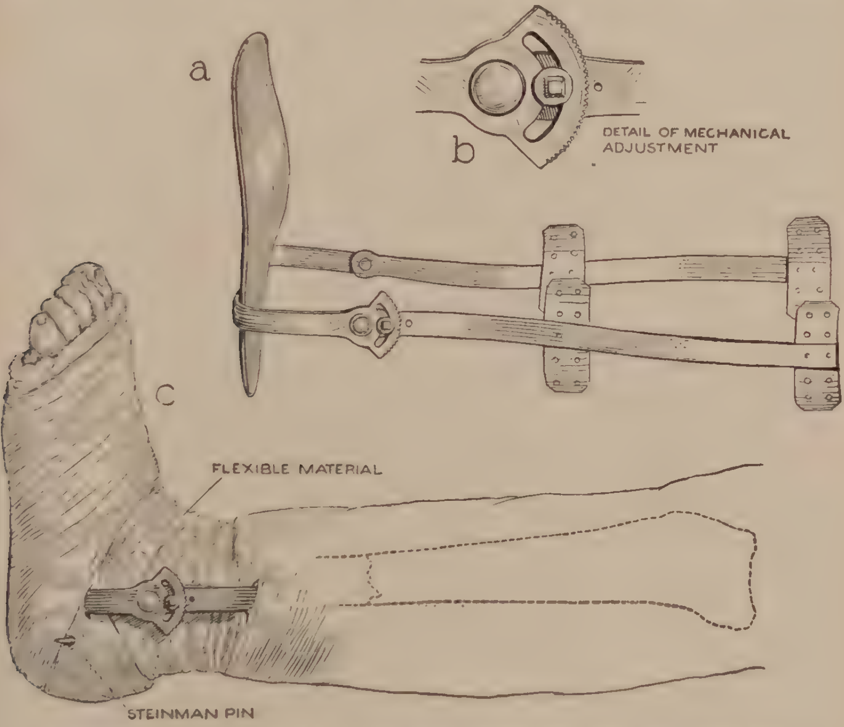

Fig. 394.—Forrester's splint for fractures into ankle-joint, associated with Steinman pin for fractures in the shaft. (From Forrester's "Imperative Traumatic Surgery," published by Paul B. Hoeber, Inc.)

the mortice is narrowed to its original width. In cases in which this precaution is not done there will be a demonstrable side slip of the foot on the leg and a greatly increased period of disability.

After a week or ten days the cast is split lengthwise, and the ankle is given increasing careful active motion, skilled massage, and daily or twice daily hot soakings or bakings with hot lamps (infra-red is very useful).

2. *Fractures of the upper end of the fibula* occur quite commonly as a complication of fractures about the ankle-joint. The violent rotation of the leg causes a torsion of the upper end of the fibula so violent as to produce a fracture. The condition is commonly overlooked because of the overshadowing symptoms in the ankle. In all fractures about the ankle-joint, it should be a routine to palpate the extent of both the fibula and the tibia, and to make an *x*-ray examination if there be the slightest suspicion of a fracture of the upper end of the fibula. Fractures of the upper end of the fibula also occur as a result of direct violence. The diagnosis is made by the elicitation of the tender point at the point of fracture and by the *x*-ray examination. Immobilization in a circular plaster cast from the toes to the groin, with avoidance of weight bearing, is the accepted treatment, although simple rest in bed for three weeks will bring about healing in most cases.

(*e*) *Tarsus.*—1. *Fractures of the Astragalus Without Displacement.*—Fractures of the astragalus may be caused by force applied to the sole of the foot, as in falls from a height. It may be accompanied by a fracture of the os calcis. The posterior process of the astragalus may exist as a separate bone, the *os trigonum*, in about 8 per cent. of normal individuals.[1] This separate piece of bone is often incorrectly called a fracture in the interpretation of roentgenograms. The os trigonum may rarely be fractured. Meisenbach[2] reported 2 cases which recovered following a brief period of rest. Fractures of the astragalus *without displacement* are readily treated by minor surgical methods (Fig. 395). The foot is put up in a split plaster cast or molded plaster splint in strong dorsal flexion. The immobilization is continuous for four to twelve weeks (Speed). Weight bearing will be deferred for one to three months (Speed). Scudder[3] says that more or less stiffness and pain may exist for four to six months after the accident. Fractures of the astragalus *with displacement* are subject to major surgical treatment.

2. *Fractures of the Tarsal Scaphoid.*—This bone may be crushed be-

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[1] Geist: Quoted by Speed.

[2] Meisenbach, R.: Jour. Amer. Med. Assoc., 89, 199, July 16, 1927.

[3] Scudder, C. L.: Treatment of Fractures, 10th ed., W. B. Saunders Co., 1927, p. 715.

tween the astragalus and the cuneiform bones. A study of this subject has been made by Wright.[1] This author says that "80 per cent. of fractures of the tarsal scaphoid occur in women wearing high-heeled pumps with open fronts, and are caused by hyperextension (plantar flexion) of the foot on the ankle-joint accompanied, as a rule, by eversion or inversion."

Roentgenograms of feet wearing high-heeled slippers show that the joint spaces are widened abnormally in the front of the tarsal joints. Consequently, when there is a sudden twist or backward thrust on the foot, the already hyperextended joints cannot stand the strain and an avulsion fracture results.

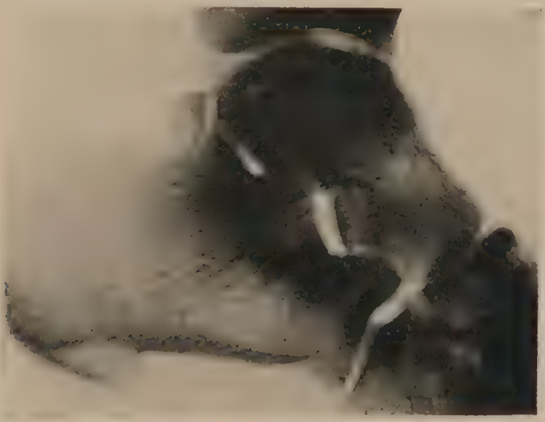

Fig. 395.—Fracture of the astragalus.

Wright reports 20 cases of fracture of the tarsal scaphoid. In 60 per cent. the scaphoid alone was involved. In others chips had been broken from the joint margin of the cuneiform and astragalus.

The treatment should consist in immobilization in straps with the foot in strong dorsal flexion for about three weeks. After three weeks an elastic bandage will be sufficient. Prolonged immobilization is useless as bony union of the detached fragment rarely results.

The treatment of fractures of the scaphoid in which there is displacement of the fragments is a problem of major surgery.

3. *Fractures of the Cuboid and Cuneiform Bones.*—The diagnosis of fracture in these bones is made by the situation of the tenderness and by the x-ray examination. The treatment will be immobilization in plaster for four weeks.

The diagnosis is made by swelling, localized tenderness, inability to bear weight on the foot, and the x-ray examination. After the swelling has started to subside a circular plaster cast is applied from the toes to the head of the tibia, and left in place for four weeks, after which physiotherapy and gradual weight-bearing are instituted.

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[1] Wright, V. W. M.: Ann. Surg., 1928, 87, 587.

4. *Os Calcis.*—Falls upon the heels not uncommonly cause fractures of the os calcis. Violent traction of the tendo achillis may produce an avulsion fracture (Fig. 396). The more severe grades of this injury will require major surgical treatment. Where, however, the os calcis has been compressed so that its lateral surfaces bulge outward, the treatment will be minor surgical. The foot is placed upon a hard object and the lateral surface of the os calcis is struck a sharp blow with a paddled mallet or hammer. Or an attempt may be made to narrow the fractured mass of the os calcis by the use of padded metal calipers which squeeze the separated bone together.[1] By either method the unnatural lateral convexity of the fractured os calcis may be corrected. Immobilization in a plaster cast and avoidance of weight-bearing will be required for a period of six weeks. This may be followed by baking and massage, but weight-bearing is not permitted for a considerable period of time, three to six months (Speed), two months (Scudder).

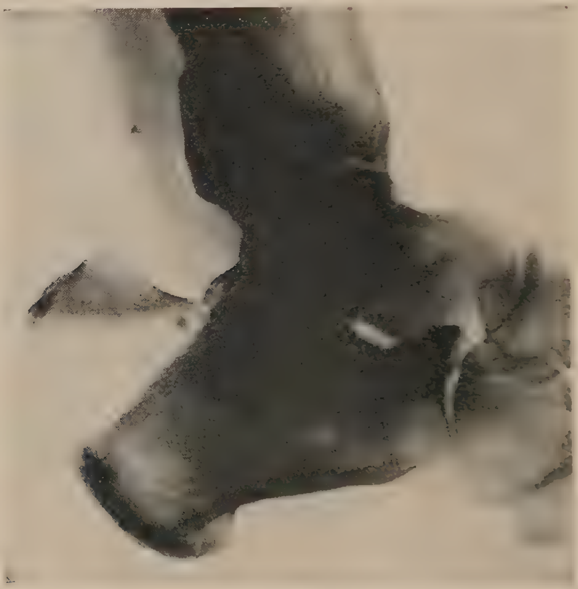

Fig. 396.—Avulsion fracture of the os calcis. (Courtesy of Dr. John T. Hart.)

5. *Fracture of the Sustentaculum Tali.*—Forcible inversion of the foot

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[1] Harding: Jour. Bone and Joint Surg., 8, 720, quoted by Speed.

may break off or impact the sustentaculum tali into the cancellous bone of the os calcis. The points in the diagnosis include tenderness localized over the sustentaculum, foot in forced abduction, valgus position in walking, swelling on the inner side of the heel, pain in the heel on attempts at weight bearing, shortening of the heel by slight displacement of the os calcis forward. The treatment consists in the immobilization of the slightly inverted foot in plaster of Paris for six to eight weeks.

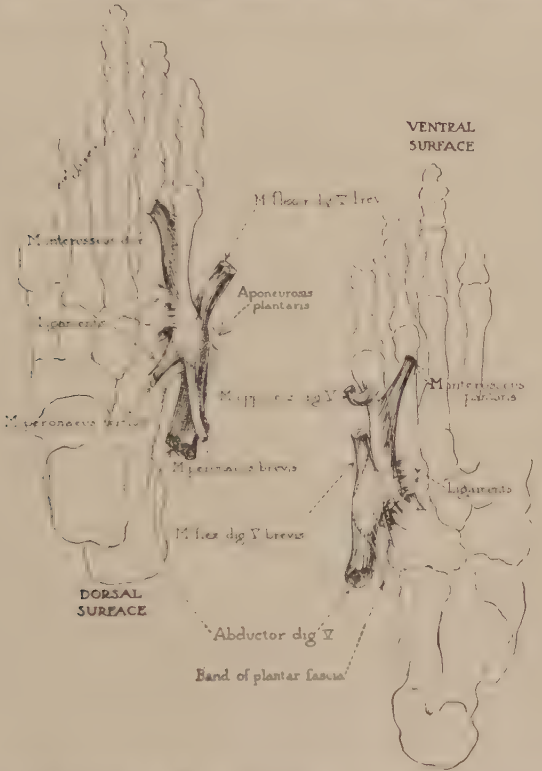
VENTRAL SURFACE
M flexor dig V brev
M interosseus dor
Aponeurosis plantaris
Ligamentis
M opponens dig V
M interosseus plantaris
M peronaeus tertius
M peronaeus brevis
Ligamentis
M flex dig V brevis
DORSAL SURFACE
Abductor dig V
Band of plantar fascia

Fig. 396a. - Showing anatomy of fifth metatarsal, ventral and dorsal surfaces. (Christopher, Frederick, Surg., Gyn., and Obst., August, 1923.)

Speed[1] advises that a metal insole worn during the first three months of weight bearing may help strengthen the foot if it does not cause pain by pressure. Complicated or old fractures are subjects for major surgical treatment.

(*f*) *Metatarsals and Phalanges.*—1. *Metatarsals.*—The metatarsals are very commonly fractured by direct violence as the result of the falling of heavy objects upon the foot (Fig. 397). Occasionally they may be broken by indirect or muscular violence. The base of the fifth metatarsal is particularly liable to this injury (Fig. 396a), and is often mistaken for a "sprain."[1] The diagnosis of fracture of the base of the fifth metatarsal is made by pain, swelling, and tenderness on palpation at this area and by *x*-rays (Fig. 398). Between the ages of eleven and sixteen years the epiphysis of the tuberosity may be mistaken for fracture. The proper treatment is immobilization in a plaster cast for a period of two or three weeks.

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[1] Speed, Kellogg: Fractures and Dislocations, 2d ed., Lea & Febiger, p. 870.

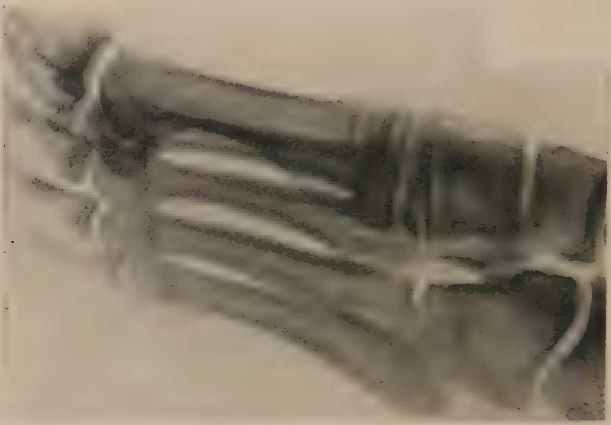

Fig. 397.—Greenstick fracture of the shaft of the fourth metatarsal.

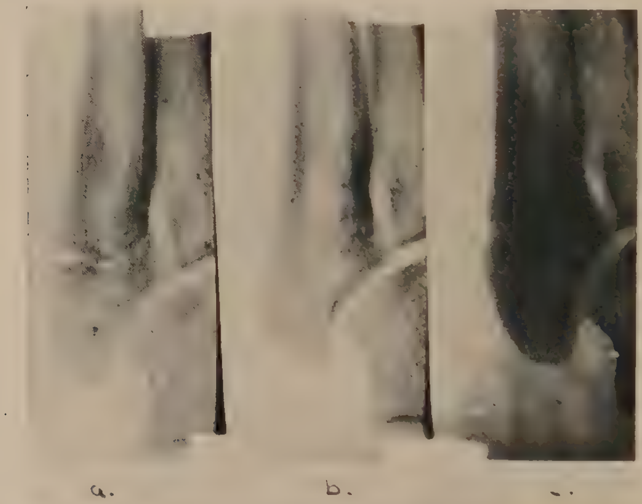

Fig. 398.—Fracture of the base of the fifth metatarsal: *a*, Fresh fracture. *b*, Fifth metatarsal on the opposite foot. *c*, Healed fracture shown in *a*.

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[1] Christopher, Frederick: Surg., Gynec., and Obst., August, 1923, p. 190.

Carp[1] reported 21 cases of fracture of the fifth metatarsal bone. He considered that there was a tendency toward delayed union because of the poor blood-supply. Carp believes that physical therapy should be instituted early, and that weight-bearing should be carried out before a month to prevent bone atrophy. Cod-liver oil or "Oscodal" (Metz) should be given. Corbusier (discussion of Carp's paper) does not see the necessity of putting these fractures in plaster casts. Carp believes that scarification of the fractured bone-ends by means of a needle introduced through the soft parts to produce bleeding may stimulate union. Where there is avulsion of a fragment at the base of the fifth metatarsal Ellis and Coulter[2] advises that the fragment be tacked in place under guidance of the *x*-ray.

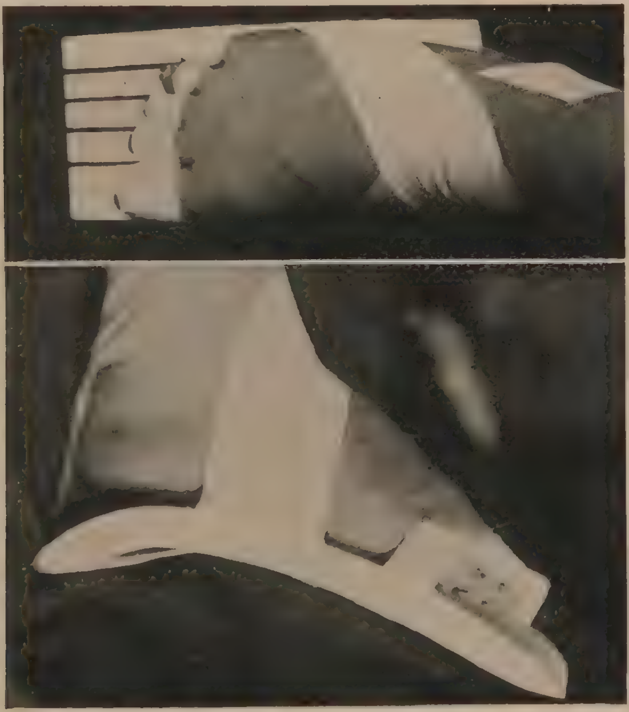

Fig. 399.—George G. Davis splint for fractures of the metatarsals. (Ellis and Coulter, Jour. Amer. Med. Assoc., July 14, 1928.)

For fractures of the shafts of the metatarsals the principles of Ellis and Coulter (loc. cit.) should be followed out. These authors believe that there should be effectual immobilization preserving or exaggerating the concavity of the foot in slight supination with traction of the forepart of the foot. This method will not only maintain extension in metatarsals, and thus assure the alignment of their shafts, but in the case of crushed tarsals will relieve pressure upon them and their injured ligaments and joint cartilages. These authors recommend the use of the splint devised by Dr. George G. Davis, of Chicago (Fig. 399). The splint is made of a curved board about $\frac{3}{4}$ inch in thickness. This is curved upward into the plantar concavity of the foot, the anterior end being sawed into separate projections, to which the toes are strapped with adhesive tape. The ball of the foot is firmly bound to the splint by adhesive and gauze bandages, and then the splint is sharply forced forward. This puts powerful extension on the heads of the metatarsals by pressure of the curved part of the splint against the sole of the foot just proximal to the heads of the bones. Some traction is also exerted by the adhesive strapping of the toes. The splint is then firmly fastened in position by bandages, and adhesive tape is passed around the posterior end and across the ankle-joint in front. The extension thus exerted overcomes the pull of the muscles and ligaments on the crushed tarsals and extends the joint capsules and collateral ligaments of the tarsometatarsal and intertarsal joints to the maximum. Just as in the management of fractured fingers (Mock and Ellis), the stretching of capsules and ligaments and the prevention of pressure on the crushed phalanges and fractured joint surfaces during healing is much more important in the restoration of function after healing of the fractures than is the consideration of maintaining exact reduction of bone fragments. Such a splint prevents all possibility of plantar angulation of the fractured metatarsal shafts, which is a point of great practical importance.

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[1] Carp, Louis: Amer. Jour. Surg., n. s. iii, p. 182, August, 1927.

[2] Ellis, J. D., and Coulter, J. S.: Jour. Amer. Med. Assoc., 91, 81, July 14, 1928.

The general rule for the maintenance of splinting and extension with this appliance is four weeks, with a further period of from two to four weeks before weight is borne on the foot.

In the reduction as little manipulation as possible is done, reliance being placed principally upon extension. The after-care of fractures of this type consists in skilful massage and heat. The latter is given by a baker, a radiant heat lamp, contarst baths, or by diathermy. When the patient starts to walk, a plantar felt pad is worn, and the patient is instructed in exercises which strengthen the muscles and ligaments of the foot and ankle.

2. *Phalanges.*—Fractures of the phalanges occur from direct violence, either by falls of heavy objects upon the toes or by the traumatism sustained in kicking the foot against hard objects. The chief difficulty in the treatment of this condition is the failure to recognize its ex-

istence. All cases of traumatism to the toes should be subjected to x-ray examination (Fig. 400). If the position of the fragments is proper, recovery will occur with the minimizing of walking and with the employment of an adequately cut out shoe.

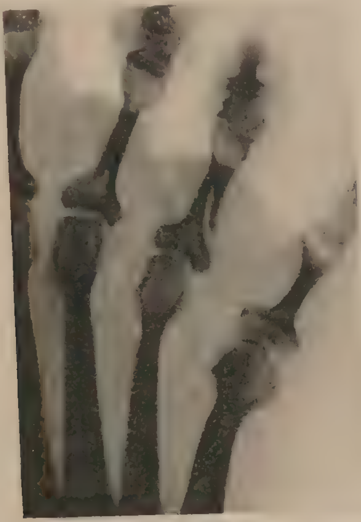

Fig. 400.—Fracture of the shaft of the proximal phalanx of the fourth toe.

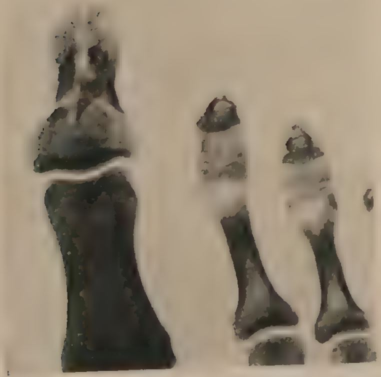

Fig. 401.—Comminuted fracture of the distal phalanx of the great toe.

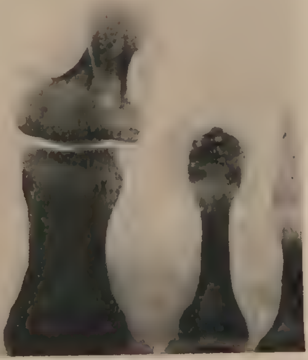

Fig. 402.—Fissure fracture of the distal phalanx of the great toe.

Fractures of the distal phalanges, in particular, do not require splinting (Figs. 401, 402). Adhesive plaster splintage of the affected toe, so that it is relatively immobilized in regard to itself and in regard to the foot, is useful. Scudder[1] recommends a simple plantar splint of splint wood, padding of the toes, and adhesive plaster straps, and says that if the plantar splint covers the entire sole of the foot, it will prove of great comfort. Barnard[1] has described a method of altering old shoes by the insertion of a steel plate under the sole, and over the toe so that walking is possible without motion of the joints of the toe.

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[1] Scudder, C. L.: Treatment of Fractures, 10th ed., W. B. Saunders Co., 1927, p. 726.

24. **Kohler's Disease (Metatarsal Scaphoiditis).**—Kohler, of Wiesbaden, in 1908 described a peculiar developmental anomaly of the tarsal scaphoid. It most commonly occurs between the ages of three and seven years, and is accompanied by pain which is made worse by exercise. There may be a tender red swelling over the scaphoid bone. The x-ray examination, by which the diagnosis is made, generally shows an irregularity in the shape of the bone. The structure of the bone itself is irregular and dense. Konjetzny[2] agrees with Axhausen that in Kohler's disease, Perthes' disease, and cases of necrosis of the semilunar bone we are dealing with a subchondral epiphyseal necrosis with little or no destruction of cartilage. On the basis of one very carefully studied case, Seldowitz and Zimtbaum[3] believe that Kohler's disease is a manifestation of rickets. They say that the condition of the blood and the prompt improvement following antirachitic therapy support this contention. Various treatments, even operative, have been advised. Ely[4] says that complete recovery "always takes place with any treatment." The symptomatic treatment is probably the best. The child is put to bed, in mild cases, until the tenderness and pain have disappeared. A plaster cast will insure rest until the patient is symptom free. Ely (loc. cit.) has pointed out that "roentgen-ray examination shows that the apparently hopelessly damaged bone slowly develops and becomes normal in structure and shape."

Metatarsal Epiphysitis.—In this condition there is a painful destructive process of the head of the second (less frequently the third or even the fifth) metatarsal. The condition is not unlike Kohler's disease as it has a tendency to undergo a spontaneous cure. The x-ray appearance is characteristic. Mouchet[5] says that the evidence given by the x-ray should be the guide to treatment. There should be rest and immobilization in plaster, allowing the patient to walk on crutches. If osseous repair is adequate at the end of six months, careful walking should be allowed.

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[1] Barnard, H. I.: Colorado Medicine, March, 1927.

[2] Konjetzny: 50 Tag. d. deutsch. Ges. f. Chir., Berlin, 1926.

[3] Seldowitz, A. M., and Zimtbaum, L.: Jour. Amer. Med. Assoc., 90, 1617, May 19, 1928.

[4] Ely, Leonard W.: Arch. Surg., 16, 560, February, 1928.

[5] Mouchet, A.: Jour. Bone and Joint Surgery, 11, 93, January, 1929.

25. **Ingrown Toe-nail (Unguis Incarnatis).**—This common ailment which is generally seen on the outer margin of the great toe, though sometimes on the inner margin, is almost always the result of wearing shoes or stockings which are too tight, coupled with the ill-advised custom of trimming the corners of the nails off down below the skin edge. The skin at the corner of the shortened nail is subjected to a repeated traumatization, ulceration and infection invariably taking place. In neglected cases a considerable amount of granulation tissue grows up from the ulcerated area which occasionally may be controlled by the use of silver nitrate stick. The condition is usually very painful and the patient will often aggravate it by cutting off the visible corner of the nail, leaving a buried projection of nail which only makes the matter worse (Fig. 403).

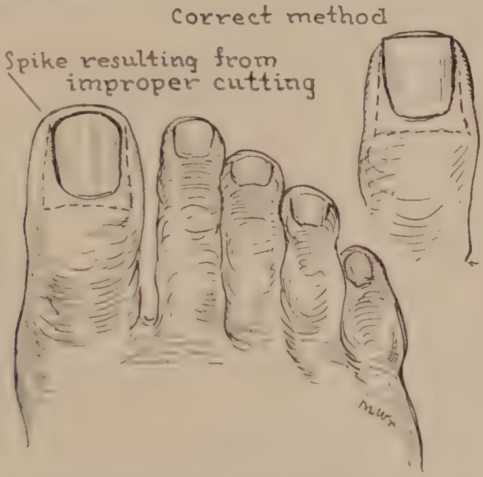

Fig. 403.—Improper and proper methods of cutting toe-nails.

The most important part of the treatment of ingrown toe-nail is the prophylactic. This consists of shoes and socks of proper size and shape, and the proper cutting of the nails. These should be cut straight across or only slightly curved so that the nail itself projects beyond the skin. The nail should not be trimmed by cutting far down into the corners at the skin edges. In early and mild cases with slight amount of infection a day of warm boric fomentations and the subsequent wearing of a shoe with a cut out toe will generally clear up the condition. The foot is washed with soap and water twice daily, and rinsed with alcohol. Powdering the irritating edge of the nail with aristol or bismuth subnitrate has been advised. Vaughan and Burnham[1] advise that

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[1] Vaughan, J. C., and Burnham, A. C.: Minor Surgery, Lea & Febiger, 1922, p. 444.

"if infection occurs, most cases can be cured by packing a small wick of cotton between the edge of the nail and the skin and beneath the nail in such a manner as to evert the edge of the nail." These authors use a wick which has been dipped in a mixture of equal parts tincture of iodine and alcohol. Certain cases are benefited by inserting under the corner of the nail a small wisp of cotton. Mickel[1] introduces a piece of gauze soaked in celluloid solution under the ingrowing part of the nail and repeats this procedure in a few days. Some patients have cured themselves by allowing the nail to grow so long that it curves over the end of the toe by pressure of the shoe or sock. This tends to force the lateral edges of the toe-nail upward (Vaughan and Burnham).

In long-standing and neglected cases, and in those where the patients persist in wearing pointed shoes, some type of operation is indicated. The surgical cure of ingrown toe-nail is not easy and will require the strictest attention to details. The usual operation is done under local anesthesia. The dorsal and plantar nerve branches are blocked with 0.5 per cent. procaine. The placing of a tourniquet at the base of the toe is painful and generally unnecessary. The entire toe and surrounding region is carefully painted with full-strength tincture of iodine, which in delicate skins may be washed off. The point of the scalpel is inserted directly downward through the skin above the eponychium about $\frac{1}{8}$ to $\frac{1}{4}$ inch above the visible nail base, and about $\frac{1}{16}$ inch to the inside of the lateral nail border. The scalpel point is carried down until it comes in contact with the periosteum of the distal phalanx. The scalpel is then drawn steadily downward through the distal extremity of the nail and toe. A similar incision is now made through the skin far enough to the side so that none of the lateral nail border is left behind (Fig. 404, *B*). It is also important that all of the nail matrix down to the periosteum be removed as a preventative against the growth of little isolated horns of nail. The wound is sometimes curetted. It is now customary to pack the resulting wide wound (vaseline gauze is useful) and allow it to heal from the bottom by granulation. The author has found, however, that the time of healing is greatly shortened by placing one or two interrupted silk stitches at the proximal end of the wound to approximate its edge. A dry or compound tincture of benzoin dressing is applied. The patient is kept off of his foot for a few days and is then allowed to get about with a well cut out shoe or slipper. Unless there be evidence of infection or hemorrhage, the first dressing should be deferred until the third or fourth day. The second dressing may be a few days later. After that the dressings may be done daily.

[1] Mickel: Deutsche med. Wchnschr., 51, 443, March 13, 1925, quoted by Winograd.

If marked infection develops, hot boric fomentations may be necessary. In order to lessen the healing time of the large wound, some surgeons employ grafts. Grafts from nearby areas have been used by Quénu and Princeteau. Cotte[1] uses skin-grafts from the thigh. If there is no infection, the grafts may be applied immediately. They are immobilized by a firm dressing which is not changed for eight days.

A very simple and often curative method of treating ingrown toe-nails is the avulsion of the entire toe-nail under gas anesthesia. The ulcerated nail sulcus has ample time to heal as the new nail is growing out, and there may be no recurrence. The convalescence is longer however.

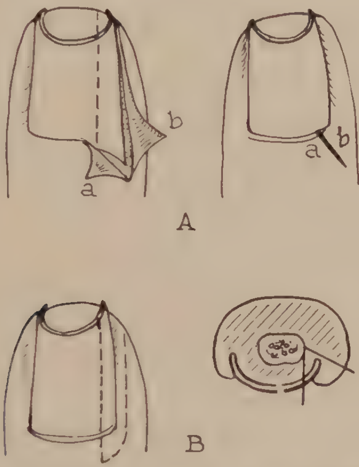

Fig. 404.—*A*, Winograd operation for ingrowing toe-nails. The paronychium is not resected. *B*, Customary operation for ingrown toe-nails.

Winograd[2] has recently reported a method of treating ingrowing toe-nails which is so rational, so simple, and has given such good results in his hands and also in the author's, that the method as described in his article is reproduced here verbatim:

"1. A tourniquet, which serves both to make the field bloodless and act as a partial nerve-block, is applied at the base of the toe. A small piece of rubber tubing is best for the purpose. (The tourniquet may be omitted—F. C.)

"2. Sterilization of the field is obtained by iodine and alcohol.

"3. Anesthesia is produced by the injection of 0.5 per cent. procaine at the base of the big toe on both sides down to the bone, thus blocking off the nerves to the part to be operated on.

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[1] Cotte, G.: Lyon chir., 1928, 25, 3, 59.

[2] Winograd, A. M.: Jour. Amer. Med. Assoc., 92, 229.

"4. A small incision is made in the soft tissue of the nail fold and eponychium on a line with the incision to be made in the nail, and extending back to the matrix.

"5. Chiefly, by blunt dissection, the soft tissue is separated from the ingrowing piece of nail until the lateral margin of the nail is reached. This piece of tissue, which previously was removed, is retracted and preserved.

"6. With small pointed scissors the nail is cut about $\frac{1}{8}$ to $\frac{1}{4}$ inch from the visible margin, the incision extending back to the end of the matrix.

"7. The loose piece of nail is grasped with forceps and, by gradual traction and separation from the nail bed, may be removed in one piece (Fig. 404, *A*).

"8. With a small curet the matrix and nail bed are curetted back to the innermost corner, so as to prevent recurrence of nail growth.

"9. The wound is then treated with mercurochrome and packed with a small piece of sterile petrolatum gauze. The tourniquet is removed and the soft tissue replaced.

"10. Daily dressings for a few days are necessary, after which the toe may be dressed every two or three days.

"In cases in which there is marked swelling and suppuration it is advisable to soak the foot in hot water containing boric acid for several days before the operation. Pain during the first night after the operation may be relieved by a barbital preparation, although this is often not necessary if the technic described is employed. Throughout the postoperative course the toe maintains a practically normal appearance. A small incision in the eponychium is the only visible evidence of the operation, whereas by the old method there is a raw, open surface, usually infected. The swollen overgrown tissue returns to normal size, and soon has the same appearance as the tissue on the unaffected side. With proper care infection should not be present, and there is little danger of extension from previous infection as no wide blood channels are opened. Within a few days the patient should be walking on the foot."

The following is a summary of a group of Winograd's cases:

Patient.	Operated on.	Pain.	Degree of infection.	Able to walk.
K. R.	10/ 8/28	Very slight.	None.	Fourth day.
K. M.	9/ 4/28	Moderate for two days.	None.	Third day.
M. M.	9/29/28	None.	None.	Second day, wore shoe on third day.
L. L.	10/ 1/28	Slight for seven days.	None.	Third day.
C. B.	9/ 5/28	Very little.	None.	Second day.

26. **Fractures of the Sesamoid Bone of the Great Toe.**—These fractures are caused by a misstep in walking or jumping, and are characterized

by sharp local pain, and some swelling. The diagnosis is made by the *x*-ray. Koch[1] says that the treatment of these fractures consists in rest in bed, early massage, and hot-air therapy, and where there is considerable callus, extirpation. According to Delageniere[2]: "The only effective treatment is extirpation of the fractured sesamoid. This is a very simple operation which can be performed under local novocaine anesthesia. A small incision 2 or 3 cm. long is made on the inner border of the foot, the tendon of the flexor brevis is found, and the sesamoid is isolated and removed." (See also Hobart.[3])

27. **Frost-bites.**—The toes are particularly liable to frost-bite and the treatment of this condition has been described elsewhere.

28. **Burns** of the lower extremity will be treated in accordance with the measures outlined in the chapter on Burns.

FIRST AID IN MAJOR SURGICAL INJURIES OF THE LOWER EXTREMITY

Severe crushing wounds and traumatic amputations of the lower extremity may occasion such a profuse hemorrhage that death will eventuate unless proper first-aid measures be taken. These will consist of the application of a tourniquet above the bleeding point, and the treatment of shock. The patient will be removed to the hospital as rapidly as possible.

In cases of fractures of the femur the first aid treatment consists in the proper application of a Liston splint. This splint is simply a strong, well-padded board which extends from the axilla to the sole of the foot. It is firmly bandaged to the thorax and abdomen, and continued on as a spica round the thigh, leg, and foot. Where first-aid conditions permit, the proper application of a Thomas traction splint is preferable. Once the splint has been applied it will be more important to treat shock if it be present than to speed up the transportation of the patient to the hospital.

In cases of fracture of both bones of the leg the first-aid splint should extend from the groin to well below the foot.

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[1] Koch, K.: Münch. med. Wchnschr., 1924, 71, 1235.

[2] Delageniere, H.: Bull. et mém. Soc. nat. de chir., 1925, 51, 722.

[3] Hobart, M. H.: Jour. Bone and Joint Surg., 11, 298, April, 1929.

CHAPTER XXII

INFECTIONS, TUMORS, AND DEFORMITIES OF THE LOWER EXTREMITY

I. INFECTIONS

1. **Cellulitis, Lymphangitis, Boils, Carbuncles, and Abscesses.**—The diagnosis and treatment of these conditions have been described previously.

2. **Acute Suppurative Tenosynovitis.**—This condition is far less common in the lower extremity than in the upper because the feet are protected by shoes, and because the hands are exposed to far more numerous traumata. The principles of treatment are the same, however, as in the upper extremity, and the perils of the infection are as great.

3. **Osteomyelitis** is of frequent occurrence in the long bones of the lower extremity. The diagnosis and treatment are given elsewhere.

4. **Perforating Ulcer of the Foot (Mal Perforans).**—In this condition there is a perforating ulcer on the plantar surface of one foot. Occasionally it is bilateral. It is generally situated in the neighborhood of the metatarsophalangeal joint or the pulp of the great or little toe. DaCosta[1] believes that the lesion is dependent upon both. It occurs with nerve lesions, diabetes, rheumatism, syphilis, etc., arteriosclerosis, and peripheral neuritis. The ulcer begins in the neighborhood of a corn, and is accompanied by suppuration. Numerous treatment, including periarterial sympathectomy have been advised, but rest in bed with continuous hot boric fomentations is very useful. A permanent cure is difficult. Attention should be directed to the underlying general condition and this should be treated if possible. For the local treatment, Vaughan and Burnham[2] advise "the thick horny layer of epidermis should be removed with a sharp knife or by repeated applications of salicylic ointment (10 to 20 per cent.). The ulcer may then be packed with gauze soaked in balsam of Peru or some other stimulating agent. The gauze should be changed at frequent intervals. If this treatment is carefully carried out, and the patient is kept off his foot during the period of treatment, a few cases may be cured."

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[1] DaCosta, J. C.: Modern Surgery, 9th ed., W. B. Saunders Co., 1926, p. 87.

[2] Vaughan, J. C., and Burnham, A. C.: Minor Surgery, Lea & Febiger, 1922, p. 442.

5. **Ainhum (Dactylolysis Spontanea).**—This rare condition, which occurs chiefly in Africa, South America, and in the Southern United States, is of unknown etiology, although parasites may play a rôle. A furrow forms at the base of the little toe and gradually becomes deeper, and if left to itself "may last for two to ten years, and eventually end in removal or sloughing of the toe."[1] The early stages may be treated by longitudinal incision into the furrow.

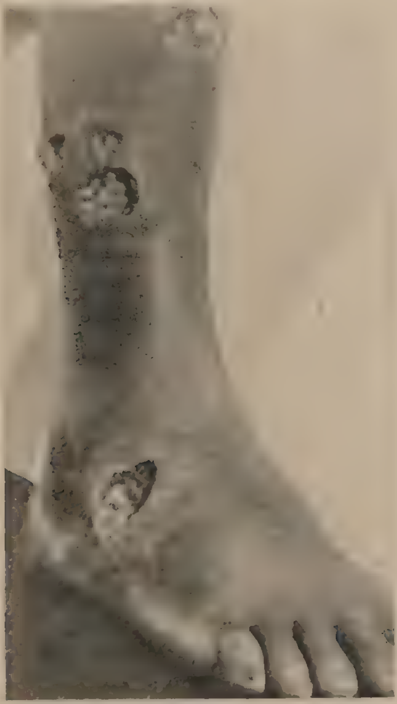

Fig. 405.—Tertiary lues. (Courtesy of Dr. Edward A. Oliver.)

6. **Ringworm Infections.**—A ringworm infection is a not uncommon complication of a traumatic wound. After a study of this subject McNealy and Lichenstein[2] conclude:

"Prophylaxis against ringworm infection should be brought to the attention of all men doing traumatic surgery.

"Ringworm infections very often contribute to the chronicity of traumatic wounds of the extremities, especially those about the toes.

"In all chronic cases which remain moist and in which delayed healing is associated with blebs and a scaling epidermis, the presence of the tinea should be suspected.

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[1] Baldwin, H. S.: Cecil's Practice of Medicine, W. B. Saunders Co., 1927, p. 338.

[2] McNealy, R. W., and Lichtenstein, M. E.: Illinois Med. Jour., 55, 298, April, 1929.

"The infection usually responds to treatment directed at keeping the wound dry and supplemented by the use of such topical applications as tincture of iodine, ammoniated mercury, and Whitfield's ointment (salicylic acid, 2; benzoic acid, 4; petrolatum, 30).

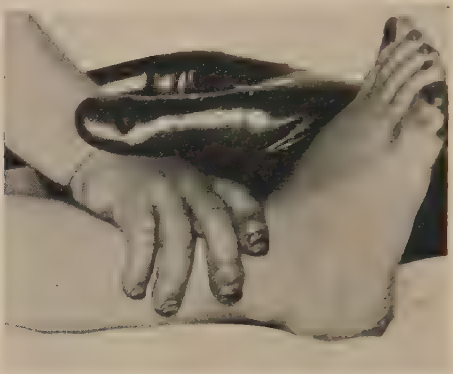

Fig. 406.—Luetic onychia. (Children's Memorial Hospital. Service of Dr. Harold Rosenbaum.)

"Ringworm dermatitis of the extremities is a frequent atrium for secondary infections, many of which become serious."

7. **Syphilis of the Lower Extremity.**—This condition has been described elsewhere (Figs. 405, 406).

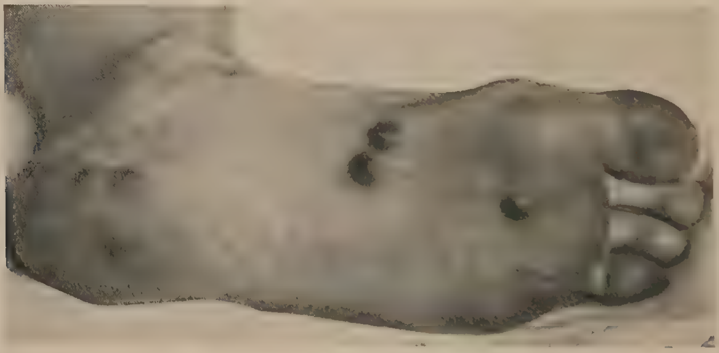

Fig. 407.—Keratoderma blennorrhagia; a complication of chronic gonorrhea. (Courtesy of Dr. Edward A. Oliver.)

8. **Gonorrhea of Lower Extremity.**—*Keratoderma blennorrhagia* is a cutaneous manifestation of chronic gonorrhea (Fig. 407). The treatment is directed toward the generalized infection, and locally is salicylic acid ointment.

II. TUMORS

1. **Sebaceous Cysts, Lipomata, and Fibromata.**—The diagnosis and treatment of these conditions have been described previously (pp. 191, 207).

2. **Angioma.**—This is a vascular tumor rarely found in the lower extremity. The treatment is identical with that of angioma described elsewhere (p. 205).

3. **Osteoma.**—(*a*) *Exostosis of the Head of the Fifth Metatarsal.*—The lateral margin of the distal end of the fifth metatarsal when subjected to continuous pressure by tight shoes will occasionally develop into exostosis which, after a period of time, may project as much as 1 cm. above the normal surface of the bone. These exostoses are extremely painful. The treatment is the excision of the exostosis through a curved incision whose convexity is upward. This operation is generally best done under general anesthesia. Utmost care must be taken for the preservation of asepsis. After the overlying soft parts have been reflected the exostosis itself is carefully removed by ronguer or by chisel.

(*b*) *Exostosis of Phalanges of the Little Toe.*—A complication of corns is the formation of an exostosis of the lateral margins of the phalanges of the little toe. The exostosis is no doubt formed in response to the continued irritation from external pressure as from a too tight shoe. The diagnosis of this condition is made by x-ray, and the treatment is the excision of the exostosis.[1] The exostosis should be removed surgically.

(*c*) *Subungual Exostoses.*—Exostoses of the distal phalanx of the great toe may develop beneath the nail (Fig. 408). The condition may be painful, and may cause an elevation of the nail. Removal of the exostosis after avulsion of the nail may bring about relief after a new nail has grown in. In many cases, however, it will be necessary to remove the nail-bed as well, to prevent the formation of future nails.

4. **Corns (Clavus).**—Corns are localized painful thickenings of the epidermis due to the continuous pressure of ill-fitting shoes. Soft corns occur between the toes where the skin is kept moist by perspiration. They may be extremely painful. Corns may become infected and suppurate. Properly fitting shoes, circular protective corn plasters, paring of the upper layers of the corn with a safety razor blade, and soaking the feet twice daily in soda bicarbonate solution (Vaughan and Burnham) will give relief or cure. Vaughan and Burnham[2] advise painting

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[1] Christopher, Frederick: Jour. Bone and Joint Surg., 8, 821, October, 1926.

[2] Vaughan, J. C., and Burnham, A. C.: Minor Surgery, Lea & Febiger, 1922, p. 444.

the corn night and morning for several days with the following mixture:

Extract of cannabis indica	0.6 gm.
Salicylic acid	2.6 gm.
Collodion and flexible collodion, of each	8.0 c.c.

At the end of this time the corn is scraped away or removed by soaking in hot water. Several courses of treatment may be necessary. The same plan of treatment may be carried out with the various proprietary corn remedies, most of which contain salicylic acid and collodion. Soft corns are treated by washing the feet twice daily in hot water and soap, sponging them with alcohol, and powdering with bismuth subnitrate, or borated talcum powder. A small piece of cotton between the toes will be useful. In the treatment of corns particular care must be taken for the preservation of asepsis. The hands, instruments, and the skin of the toe should be rendered as nearly sterile as possible before any surgical procedures are undertaken. Trustworthy chiropodists are generally the best ones to take care of corns, but one should know their qualifications before recommending them.

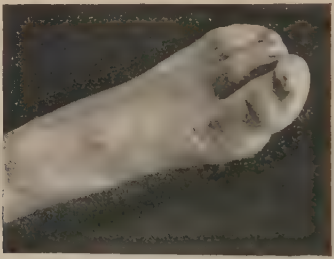

Fig. 408.—Subungual exostosis. (Surgical Dispensary, Northwestern University Medical School. Courtesy of Dr. John A. Wolfer.)

A newer conception of corns has been given us by Pust.[1] This author points out that if corns were due to the irritation of pressure, they would heal when the pressure is relieved and when the proliferation is removed. Pust says that this is not the case, and he believes that a permanently acting trophic irritation of the nerve must be responsible. His treatment is based on this conception and is as follows: From a central point the region is infiltrated with one of the usual anesthetics, and from a further peripheric point the afferent nerve or nerves are injected with a permanent anesthetic, such as alcohol. The pain presently subsides so that the patient can take long walks or make excursions immediately after the treatment. The slight edema which forms, as after any kind of anesthesia, disappears a few hours later. The thickening of the horny layer of the skin is negligible. It may be removed after a softening application, and the base is treated as usual. For a permanent result it is necessary to strike the nerves. This presents no technical difficulty, provided the cannula is held perpendicular to the axis of the toe in order to make the injection deep enough. Cases with infection and those in diabetic, arteriosclerotic, and nephritic patients are not suitable for this treatment.

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[1] Pust: Münch. med. Wchnschr., 74, 770, May 6, 1927.

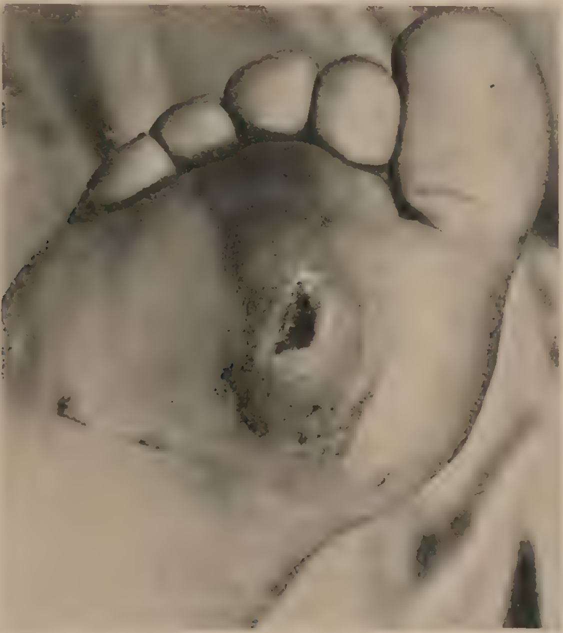

Fig. 409.—Infected callus of foot. (Courtesy of Dr. James H. Mitchell.)

5. **Callus.**—Circumscribed thickenings of the skin or collosities are similar to corns, but are generally larger in extent. A very common site is the ball of the foot (Fig. 409). The causes are too tight or ill-fitting shoes or, more frequently, a faulty transverse metatarsal arch. Corrections of the latter by proper support will generally remedy the callus.

6. **Plantar Warts** (Verrucæ).—Warts are benign hypertrophies of the skin of a papillomatous nature. In the lower extremity they commonly occur upon the plantar surface of the foot, where the continual pressure makes them dissimilar in appearance to warts on other surfaces. The surface is flat and continuous with the adjacent skin. The wart

itself may be pressed inward toward the soft parts by walking and may be very painful. It may become infected. The term "seed wart" is often applied to this condition. Plantar warts may be single or multiple, and may be accompanied by considerable painful callus formation. They may be differentiated from corns by the fact that after paring away the callus the warty, papillomatous nature of the central part will be evident. The treatment of choice of plantar warts is the application of radium and this method is far superior to any other. The method of application and dosage of the radium had best be left to an experienced dermatologist. McCafferty and McCarthy[1] report over 95 per cent. of cures of callosities and plantar warts with *x*-ray treatment. The next best treatment is excision under local anesthesia. This method, however, is not certain, and may leave a tender plantar scar.

7. **Ganglion.**—The presence of ganglia on the lower extremity is unusual. They are occasionally found in relation to the extensor tendons of the foot. The author has excised a large ganglion from the popliteal space. The treatment of ganglion of the lower extremity is identical with that of the upper extremity.

III. CONGENITAL AND ACQUIRED DEFORMITIES

1. **Syndactylism and Polydactylism.**—Syndactylism occasionally occurs on the foot, but, because of the concealment of the latter by the shoe, operative treatment rarely will be necessary. Should operation, however, be indicated, it will be done along the lines previously described in respect to syndactylism of the hand.

Polydactylism or supernumerary digits will require amputation of the offending digit in order to facilitate shoe fitting in later life. This amputation is best done very soon after birth in accordance with the methods described previously. Operation should be preceded by *x*-ray to determine the least useful digit.

2. **Hypertrophy of the Toe.**—This rare condition rarely requires treatment. When the toe is so large as to interfere with proper shoe fitting, amputation is indicated. The incision for amputation should be so placed as to produce a dorsal rather than plantar scar.

3. **Twisted Nail.**—Many cases of twisted or deformed nails are remedied by simple avulsion of the toe-nail, and this expedient always should be tried first. Where the second nail is not an improvement there should not only be an avulsion of the nail, but the removal of the entire nail-bed to prevent further regeneration of the nail.

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[1] McCafferty, L. K., and McCarthy, C. L.: Jour. of Bone and Joint Surgery, 1925, 7, 883.

4. **Hammer-toe** is a condition which most frequently involves the second toe, and in which there is an extension (dorsal flexion) of the proximal phalanx of the toe. The second and distal phalanges are flexed and a claw-like appearance results. The interphalangeal joint between the proximal and second phalanx is elevated and may be the site of a painful keratosis. The treatment of this condition is entirely surgical and three methods may be employed. For simple cases tenotomy of the extensor tendon of the toe will bring relief which is often permanent. In the more severe cases the tenotomy must be supplemented by a V-shaped excision of the prominent joint, with subsequent realignment of the phalanges. This rather formidable operation is often less advisable than the third method which consists of amputation of toe. The foot is not materially weakened by amputation of the second toe, and complete relief generally is obtained.

5. **Hallux valgus** is a bony deformity of the foot in the region of the first metatarsophalangeal joint in which the phalanges of the great toe are deflected laterally. In extreme cases the great toe may lie over or under the second toe. Complications of this deflection are the formation of an exostosis at the lateral border of the distal end of the first metatarsal, and an inflamed adventitious bursa over this exostosis (bunion). The cause is probably the wearing of too narrow or too pointed shoes, although many who wear such do not acquire bunions and hallux valgus. The prophylactic treatment is directed toward wearing the proper shoes. The curative treatment is surgical.

Operative Treatment of Bunion and Hallux Valgus—Many types of operation have been devised and all of them are most advantageously performed under general anesthesia. Some authorities, however, prefer local nerve-block anesthesia. The large majority of bunions and the lesser grades of hallux valgus may be cured by the following simple operation: A curved incision is made with the convexity upward so as to encircle the bunion. The upward convexity is chosen so as to avoid a possible painful plantar scar. The flap is reflected downward and the adventitious bursa is excised. With a straight saw the exostosis at the distal end of the first metatarsal is then sawed off so as to leave a straight lateral surface to the metatarsal. The exostosis may also be removed with a rongeur or a chisel. After the gross removal of the exostosis, the base is made smooth by a coarse rasp such as designed by Putti. The flap is then replaced, and sutured with a few interrupted sutures. The extensor tendon of the great toe is then subjected to tenotomy through a small incision opposite the tarsophalangeal joint. This tenotomy is very simply accomplished by flexing the toe dorsally, and by grasping through the skin the extensor tendon of the great toe. The tenotome is then forced through the skin beneath the tendon, which is steadied by the other hand. The sharp edge of the tenotome is held upward. The tendon is severed with a gentle sawing motion taking care not to cut too far upward and buttonhole the skin. The completion of the tenotomy is evidenced by the easy plantar flexion of the toe. The purpose of the tenotomy of the extensor tendon is to remove the lateral pull on the deflected great toe, which has only served to increase the deflection. All wounds are carefully dressed. A very useful dressing to preserve asepsis is gauze saturated in compound tincture of benzoin. A pad is placed between the great toe and the second toe, and the entire foot is encased in dressings. The patient is encouraged to move the great toe on the fifth or sixth day, but weight-bearing is not permitted for ten to fourteen days. Other operations which have been devised for the cure of bunion, and which perhaps more properly belong to the domain of major surgery, include the lateral cuneiform osteotomy of the first metatarsal (the purpose of which is to correct the deflection of the phalanges) and the Mayo operation which consists essentially of the resection of the head of the first metatarsal and the introduction into the space so formed of the adventitious bursa, which is left attached to one border and sutured with catgut into the depths of the wound.

McBride[1] has devised a conservative operation for bunions. An incision 2 inches in length is made along the external border of the extensor hallucis longus with its center over the joint. By dissecting close to the metatarsal head, the conjoined tendon of the adductor hallucis group is exposed and severed from its insertion. The conjoined tendon of the adductor muscles and the external head of the flexor hallucis brevis are transplanted into the dorsum of the head of the first metatarsal bone. The bursa is dissected out, and the bony prominence of the inner side of the metatarsal head is chiseled off. The toe is manipulated into slight over-correction and a plaster slipper is applied, which is kept on for seven to ten days. Weight-bearing is allowed at the end of two weeks, but the toe should be held in correction by adhesive plaster for four to six weeks. Cleveland[2] has reviewed the results in 200 hallux valgus operations. In this series the most satisfactory operation was resection of the metatarsal head, together with removal of the exostosis. In selected cases with only moderate hallux valgus and in which the patients complained of a painful exostosis and inflamed bursa as the chief source of annoyance, wide excision of the exostosis alone gave satisfactory results. The exostosis should be adequately removed and no bony spicules or bone sand should be left behind. The sesamoids beneath the metatarsal head should be examined as a cause of pain and removed, if necessary. A very interesting discussion of the various types of operation for hallux valgus may be found in the paper of Mau and Lauber.[1] A very satisfactory sheet metal or duraluminum postoperative splint for hallux valgus has been devised by Clayton[2] (Fig. 410).

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[1] McBride, E. D.: Jour. Bone and Joint Surg., 10, 735, October, 1928.

[2] Cleveland, M.: Arch. Surg., 14, 1125, June, 1927.

6. **Metatarsus Atavicus.**—This condition is characterized by unusual shortness of the first metatarsal as compared with the length of the second, and by tenderness on deep pressure under the second metatarsal cuneiform joint. According to Morton, "the treatment should be directed against (1) the improper distribution of weight on the heads of the metatarsals, and (2) the strain of the second tarsometatarsal joint.

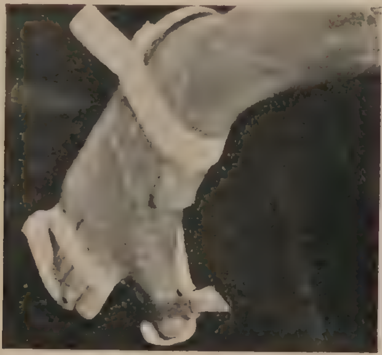

Fig. 410.—Postoperative splint for hallux valgus. (Clayton, Charles F., Jour. Bone and Joint Surg., January, 1929.)

It may be necessary, in some cases, to insist upon complete rest until the hypersensitiveness of the irritated tissues is overcome. More of the weight should be transferred to the first metatarsal. This may be done by acquiring a slight toeing-out habit. A lift of leather and felt or, in extreme cases, of metal should be placed in the shoe beneath the head of the first metatarsal. This should extend just beyond the great toe-joint and should be just wide enough to support the first metatarsal alone. It should have sufficient thickness to cause the first metatarsal to be effective in bearing the body weight and of sufficient length to act as an extension of this bone in the leverage action of the foot. Radical surgery is not indicated."

7. **Painful Heel.**—The chief causes of painful heel have been re-

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[1] Mau, C., and Lauber, H. J.: Deutsche Ztschr. f. Chir., 1926, 197–361.

[2] Clayton, C. F.: Jour. Bone and Joint Surgery, 11, 65, January, 1929.

ferred to above. They are bursitis of the bursa beneath the calcaneum and inflammation of the insertion of the plantar fascia in the os calcis. Calcaneal spurs are rarely painful.

8. **Calcaneal spurs** are osseous projections from the underside of the calcaneus (Fig. 411). They are often thought to be exclusively of gonorrheal origin. According to Lewin[1] this is grossly wrong. They may occur in relation to focal infections with ordinary cocci, gonococci, and spirochetes; with metabolic disturbances; with trauma; with static disturbances of the feet; and with a short plantar fascia. The patient should be put to bed with hot fomentations plus *Porter's lotion:*

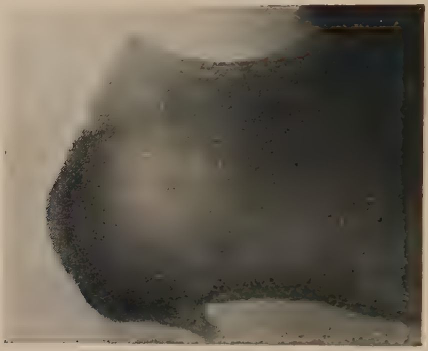

Fig. 411.—Calcaneal spur.

	C.c.
Tincture of opium	30
Diluted solution of lead subacetate	40
Tincture of arnica	50
Extract of hamamelis	60

Lewin's directions for the use of this lotion are: "The entire foot and ankle are covered by four layers of gauze saturated with the lotion and enclosed in oiled silk or rubber sheeting. Hot fomentations of strips or pads of flannel are wrung out of hot water, about six layers wrapped around the impervious layer, and another sheet of oiled silk applied." A hot-water bottle or, better, an electric pad is placed at the side or under the foot and the whole is enclosed in a Turkish towel. In case operation is decided upon, a semilunar incision is made just below the insertion of the tendo achillis. The spur and some of the underlying attached bone are removed by chisel and mallet. This operation is not easy, and a good light and adequate assistance are essential. After the operation plaster casts are applied for a period of about ten days. Lewin's comment on this condition is very pertinent. "It is highly inadvisable to remove calcaneal spurs unless they are the cause of the patient's complaint, or unless one feels that removing the spur will give the patient a comfortable foot. The situation is analogous to operating on hallux valgus; after a perfect operation, the patient may still have painful feet due to conditions outside the big toe area, such as metatarsalgia." Jones and Lovett[1] report a patient having spurs of equal size under the os calcis of both feet, but having pain in only one foot.

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[1] Lewin, Philip: Arch. Surg., 12, 117, January, 1926.

9. **Club-foot (Talipes Equinovarus).**—Talipes equinus is the plantar flexed foot, talipes calcaneus is the dorsally flexed foot, talipes varus is the inverted and adducted foot, and talipes valgus is the everted and abducted foot. Over 75 per cent. of congenital club-feet are of the equinovarus variety, and about 5 per cent. of the valgus variety. In talipes equinovarus the deformity consists of inversion of the whole foot, adduction of the forefoot, and plantar flexion. The condition may be slight or so severe that the sole faces almost upward (Jones and Lovett). If the condition is untreated the patient will reach adult life with a most awkward gait in which he walks on the outside of his foot. "The foot cannot be overcorrected by the examining hand and, from infancy on, the deformity will increase in the untreated cases" (Jones and Lovett). The treatment consists in maintaining the foot in the overcorrected position of marked dorsal flexion, marked eversion, and marked abduction until the bone has become reshaped and the ligaments and muscles have adjusted themselves to their environment and requirements. The treatment should be started as early in life as possible. "In very young children, it is probable that every case can be cured without operation, with the exception of a possible tenotomy of the tendo achillis in the final stage, by constantly repeated *manipulation by the parents*, carefully taught by the surgeon. The foot is manipulated by the mother into a position of dorsal flexion, abduction, and eversion, and it will loosen up with surprising readiness, and at the end of a few weeks will be capable of being placed in the overcorrected position without encountering resistance. Having reached this point it is only necessary to see that the contraction does not return by the use of less frequent manipulations."[2] In older children an anesthetic is given and the three deformities which make up a club-foot, namely, adduction, inversion, and plantar flexion, are corrected by hand or preferably with the Thomas wrench. The epiphyses of the tibia and

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[1] Jones, Sir Robert, and Lovett, R. W.: Orthopedic Surgery, William Wood & Co., 1923, p. 624.

[2] Lewin, Philip: Jour. Amer. Med. Assoc., 90, 1943, June 16, 1928.

fibula should be firmly grasped by the surgeon during the manipulation to avoid their straining. The knees should be flexed during the manipulation to avoid stretching the internal lateral ligament of the knee-joint —a cause of knock-knee. After the manipulation the foot is maintained in plaster of Paris in the position of overcorrection for several weeks. For the application of plaster casts in the treatment of congenital club-foot a new technic has been described by Lewin.[1] "In addition to the routine application of the casts, one applies a crossbar of plaster with a foundation consisting of two wooden tongue depressors cut to the required length. One tongue depressor is placed over and the other under the completed casts at a point about 1 inch (2.5 cm.) above the internal malleolus." The crossbar holds the extremities in any desired degree of external rotation (Fig. 412). Two or three wrenchings may be required. In older children tenotomy of the tendo achillis may be necessary. This is done with the child lying on his face. The foot is flexed dorsally so as to put the tendon on a strain. The tendon is then identified between the thumb and forefinger. The tenotome is then introduced behind the tendon and is drawn outward with a sawing motion.

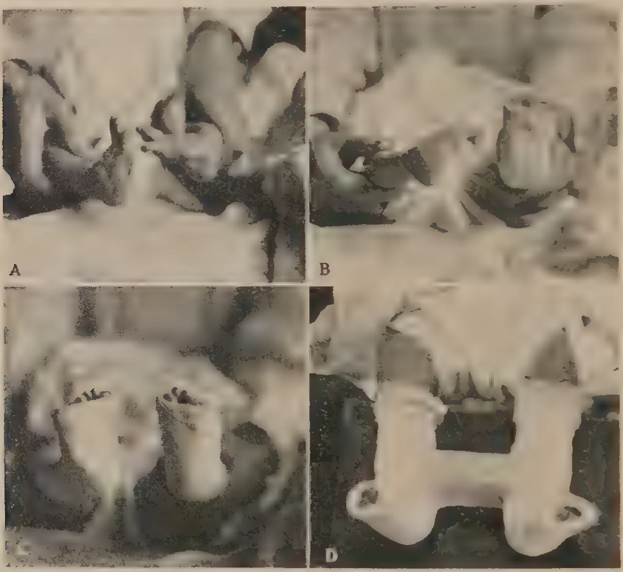

Fig. 412.—Improved technic in the application of plaster-of-Paris casts in the treatment of congenital club-foot. (Lewin, Philip, Jour. Amer. Med. Assoc., June 16, 1928.)

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[1] Lewin, Philip, Jour. Amer. Med. Assoc., June 16, 1928.

10. Flat-foot and Foot Strain.—There is no type of arch which may be called normal. According to Hoffman,[1] the height and strength of the arch are of no value in estimating the strength or usefulness of the foot, and normal feet present high, medium, and low arches, in nearly the same proportion as do feet with weakened arches. The abducted and everted feet are probably more liable to foot-strain than other feet. The symptoms of foot-strain include local stiffness and lameness, which is most marked on getting up in the morning and after an active day, pain and tenderness under the tubercle of the scaphoid, below the internal malleolus, along the ridge of the astragalocalcaneal joint, and running down to the inner side of the os calcis. The gait is peculiar in that raising the heel is avoided. There may be synovitis of the knees, backache, cramps in the soles of the feet, and in the calves of the leg. Callosities may be present under the second and third metatarsal heads, which may extend to the inner border of the foot and back to the heel. *Acute painful foot* is seen in active young children and in individuals, as nurses, who are on their feet a great deal. A preceding illness favors the condition. The treatment is rest in bed with hot foot-baths. As the tenderness diminishes massage and baking are given. The foot is strapped with adhesive plaster in a position of inversion and adduction. The strapping starts at the outer border of the foot, passes under the arch, and up the leg half way to the knee. "In the very acute cases it is well to apply, under the strapping, a pad of felt filling the arch of the foot. Weight-bearing exercises as a therapeutic measure are not advised until the acute stage is over, but active non-weight-bearing exercises may be begun as soon as they may be given without pain. In either type the exercises are to be given to cultivate adduction and inversion of the foot" (Jones and Lovett). *Flat-foot* may be congenital or acquired, and is not necessarily painful. Acquired flat-foot is of two types, the flexible and the rigid. The general principles of treatment of flexible flat-foot according to Jones and Lovett are as follows: "(*a*) If excessive weight is present, the weight should be reduced if possible. (*b*) If the general condition is poor, and the muscles consequently lax, the condition should be improved. (*c*) If overuse preceded the strain, such overuse should be avoided as far as possible. (*d*) If the patients are children, and are suffering from overwork and rapid growth, a remedy of these conditions and a cutting down of activity are indicated. (*e*) If due to unusually bad shoes, better shoes should be worn. (*f*) Mechanical defects of the feet should be sought for, identified if present, and, as far as possible, compensated." An extremely important measure in the treatment of these cases is the raising of the heel of the shoe by a wedge $\frac{1}{4}$ to $\frac{1}{3}$ inch on the inner side, sloping to zero on the outer side, and, if necessary, the placing of a small wedge on the sole just behind the head of the first metatarsal. This tilts the foot outward in walking and tends to make the patient toe inward. When barefooted, these patients should walk on their toes. They should strive to learn to walk with the toes pointing directly forward. Contrast baths and a strap of adhesive around the scaphoid are useful adjuncts. Exercises to adduct and invert the foot should be given. With proper shoes the patient should rise on tiptoe and come down on the outer side of his foot. The sole of the shoe should be stiffened in the shank by the insertion of a flat piece of metal. Jones and Lovett are of the opinion that only the very exceptional cases will require foot-plates, and that these must be of the double flange variety. In rigid flat-foot manipulation under anesthesia with the Thomas wrench and immobilization on plaster of Paris will be necessary. In young children, in addition to the crooked heel, a sloping felt pad may be worn on the inside of the shoe which supports the arch on the inner side of the foot. It may run from the base of the first metatarsal to the front of the os calcis.

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[1] Hoffman: Amer. Med., August, 1907, quoted by Jones and Lovett.

11. **Bow-legs and Knock-knees.**—The treatment of these conditions is a problem of major orthopedic surgery.

CHAPTER XXIII

MINOR SURGICAL TECHNIC

I. LOCAL ANESTHESIA

DE TAKÁTS[1] has furnished us with the most approved ideas pertaining to local anesthesia. He enumerates four contraindications to local anesthesia. (*a*) Children under fourteen years of age, and certain nervous, irritable, or mentally disabled patients. Tact and proper premedication will reduce the size of this group. (*b*) Inflamed tissue should never be injected locally. "There is no objection, however, to performing distant nerve blocks for local inflammatory conditions." (*c*) In cases of generalized infections. (*d*) In too complicated operations, as radical amputations of the breast. He lists the following advantages to the use of local anesthesia:

1. The diminution of postoperative pulmonary complications.
2. Avoidance of functional impairment in heart, liver, and kidneys.
3. Diminution in paralyses of the gastro-intestinal tract and the bladder.
4. Diminution of surgical shock.
5. Ability to have the active co-operation of the patient, as in operations upon the thyroid, etc.

Procaine (novocaine) is the most generally suitable drug to use as a local anesthetic. de Takáts says that "it is safest, whether in office work or in large hospitals, to prepare the solution from tablets that contain novocaine, or tutocaine with some adrenalin in compressed form. Most of these tablets contain 0.00012 gm. of synthetic suprarenin. Four of such tablets dissolved in 100 c.c. of the solvent give a 0.5 per cent. solution. This is the concentration most frequently used for infiltration; for nerve block a 2 per cent. solution is the best." This author considers the following solution the best solvent:

Sodii chloridi	7 gm.
Potass. sulphatis	4 gm.
Aquæ destillatæ	1000 c.c.
Acidi hydrochlorici dil	3 gtt.

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[1] de Takáts, Geza: Local Anesthesia, W. B. Saunders Co., Philadelphia and London, 1928.

The above solution, together with the dissolved novocaine, gives an isotonic concentration. The solution is sterilized in a water-bath for fifteen minutes or is autoclaved. If it is reddish brown it should be discarded. If the novocaine solution is prepared from tablets which contain no adrenalin, 10 drops (3 drops in thyroid work) of a 1 : 1000 solution should be added to every 100 c.c. of solution. The solution should be freshly prepared.

Intravenous injection will cause toxic symptoms, sudden pallor, rapid pulse, and fall in blood-pressure (de Takáts). The quantities of solution of novocaine which should not be exceeded are: 250 c.c. of a $\frac{1}{2}$ per cent. solution, 100 c.c. of a 1 per cent., and 40 c.c. of a 2 per cent.

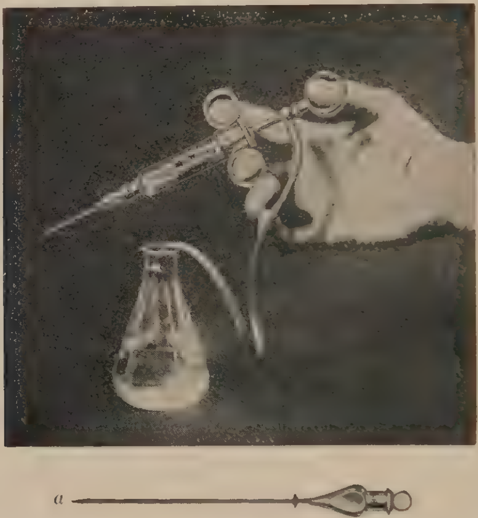

Fig. 413.—Sana-Lok Pitkin syringe for the administration of local anesthesia: *a*, Needle with security stop used in connection with the syringe. (Courtesy of Becton, Dickinson & Co.)

A preoperative hypodermic of morphine, gr. $\frac{1}{6}$ or $\frac{1}{4}$, and occasionally of scopolamine, gr. 1/200, are proper. The latter drug is not entirely without some danger. Record or Luer syringes provided with different lengths and calibers of needles will be employed. A 27-gage hypodermic needle with a short bevel is generally best for minor surgical procedures. de Takáts wisely advises sterilizing the needles and syringes by dry sterilization or boiling in distilled water. A useful syringe for the administration of local anesthesia is the self-filling, continuous-flow type (Fig. 413).[1]

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[1] This syringe is furnished by Becton, Dickinson & Co., under the name of "Sana-Lok Pitkin syringe."

The skin and subcutaneous tissues of the operative field are infiltrated with novocaine solution. If desired, the area may be indirectly infiltrated, that is by walling off the field of operation with local anesthesia, thus blocking all the sensory nerves emerging from the field of operation. When it is desired to do a "nerve block," the solution is deposited just outside of the perineurium, or in some cases the solution may be deposited within the endoneurium (de Takáts). Of recent years local anesthesia has been used increasingly in the reduction of fractures and dislocations (Fig. 414). Whereas infiltration anesthesia may be used, the nerve-block type is probably superior. The methods of inducing nerve block have been studied at the Marburg Clinic and have been reported by Mueller,[1] "In fractures and dislocations of the arm, the plexus anesthesia of Kulenkampff is induced, and in those of the leg various nerves are excluded according to the method of Laewen. The sciatic nerve is injected according to the method of Keppler at its point of exit from the sciatic notch, and the femoral nerve is injected under Poupart's ligament 1 cm. lateral to the femoral artery. The obturator nerve is reached at the external margin of the obturator foramen, at a point one fingerbreadth below the spine of the os pubis, the needles being introduced upward and outward. The cutaneous femoris lateralis nerve is blocked according to the well-known method of Nystriem by a subcutaneous injection below the anterior superior spine of the ilium."

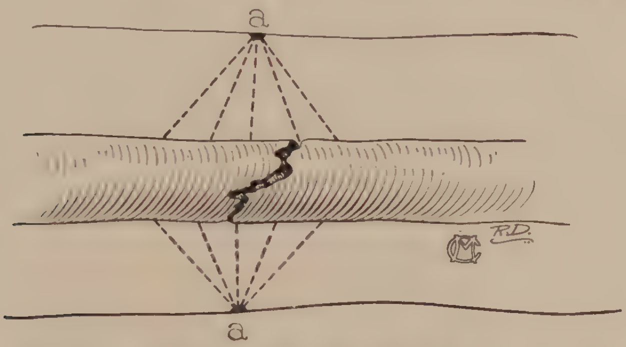

Fig. 414.—Treatment of fractures with local anesthesia: *a*, Site of injection. (Lundy, J. S., Proceedings Staff Meetings of the Mayo Clinic, 4, 77, March 6, 1929.)

Mayer[2] has made a study of fatalities from local anesthetics. His most recent report is supplementary to one made four years previously,[3] and in the latest study he has found fourteen additional deaths. The local anesthetics used in these cases were: Cocaine, 3; cocaine-procaine, 2; procaine, 8; butyn, 1. Seven of the operations were tonsillectomies; one for accidental injury to the axilla; one for prolapse of the rectum; one for hemorrhoids; one for duodenal ulcer; one for inguinal hernia. Mayer says that after eight years of study on the subject he still feels that procaine hydrochloride is undoubtedly the safest of all the local anesthetics now in general use.

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[1] Mueller, W.: Med. Klin., 1926, 22, 327.

[2] Mayer, Emil: Jour. Amer. Med. Assoc., 90, 1290, April 21, 1928.

[3] Mayer, Emil: Jour. Amer. Med. Assoc., 82, 877, March 15, 1924.

II. MINOR SURGICAL PROCEDURES

1. **Spinal puncture** is performed for a wide variety of diagnostic and therapeutic purposes. It consists essentially of introducing a hollow needle into the subdural space of the spinal cord. The position of the patient is of extreme importance for the success of the puncture. That of choice is placing the patient upon his side at the edge of the bed, with the spine in hyperflexion. This is obtained by asking the patient to lock his elbows under his knees and tightly draw the knees upward and force the head downward (Fig. 415). Often it will be necessary to have an assistant maintain this position. Many prefer to have the patient sit upright upon a stool or table and bend far forward with the back in acute flexion (Fig. 416). The purpose of the hyperflexion is to widen the intravertebral spaces and thus to facilitate the introduction of the needle. The site of the election for a spinal puncture is the aperture between the third and fourth lumbar vertebræ. This space is opposite the crest of the ilium. Having placed the patient in position, the skin is painted with iodine for an area of about a foot square, and is draped with sterile towels. The surgeon will scrub his hands, wash them in alcohol, and put on rubber gloves. It will be well to make a

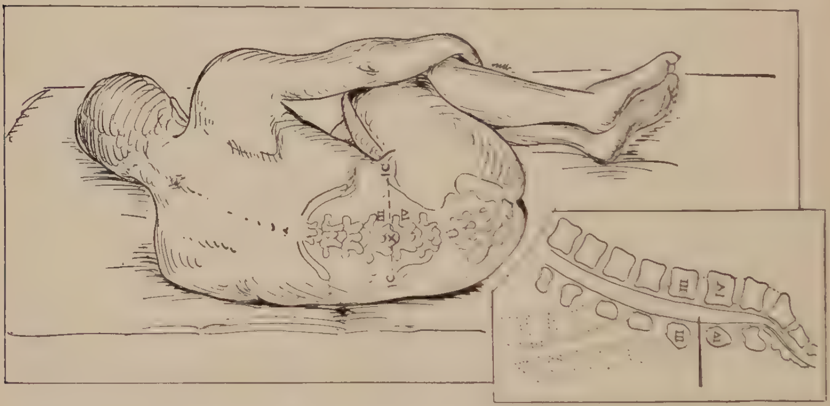

Fig. 415.—Lateral position of patient for spinal puncture. Site of puncture at x.

special mark with iodine to indicate the level of the crest of the ilium as a guide to the site of the puncture. Careful palpation will demonstrate the depression between the spines of the third and fourth lumbar vertebræ. A wheal in the skin at this point is made by instilling a drop of local anesthetic solution. The needle may be inserted more deeply, and a small quantity of the local anesthetic solution injected below the skin. The point of a lumbar puncture needle is now forced through the skin in exactly the midline midway between the spines of the third and fourth lumbar vertebræ. One-half inch lateral to the midline is advised by some authorities. After the needle has penetrated the skin it will be well to check its direction. The spine is viewed from the end to be sure that the needle is directed at right angles to the surface of the back and moreover that it is at right angles to this surface as regards the longitudinal plane. Occasionally it is necessary to point the needle somewhat in an upward direction toward the head. With careful, firm pressure the needle is then forced into the back. It may impinge upon the bony surface of the vertebra, in which case it is slightly withdrawn and the direction modified slightly until it may be felt to pass between the vertebræ to a depth of some 2 inches. When the point of the needle pierces the dura a peculiar sensation of release of resistance will be appreciated. The stylet of the needle is then withdrawn to see if the canal has actually been entered. If so, spinal fluid will at once drop out through the end of the needle. If not, the needle should be withdrawn part way, its direction checked, and then be reintroduced.

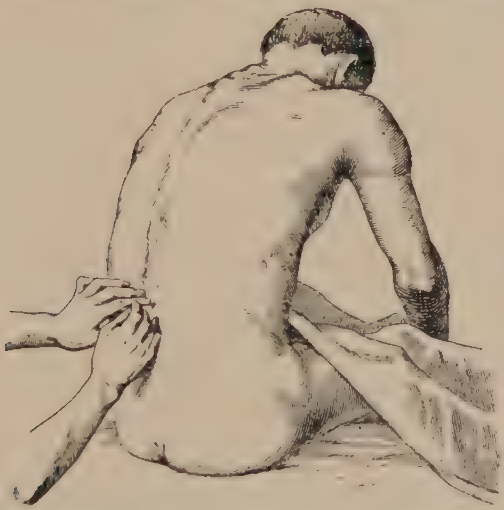

Fig. 416.—Vertical position for spinal puncture. (Maisonnet, "Petite Chirurgie.")

Spinal puncture should never be taken lightly. Where the procedure is done for purposes of diagnosis in suspected skull fracture, it is important that only a small quantity of fluid be withdrawn, and this slowly. A rapid release of pressure in the spinal canal in cases of increased intercranial pressure has brought about immediately fatal results by the forcing of the brain stem into the foramen magnum. Sterile flamed test-tube should be in readiness to catch this fluid. About 3 or 4 c.c. should be put in each of three test-tubes when a routine examination is desired. In case it is desired to estimate the pressure of the spinal fluid a manometer is attached immediately upon withdrawal of the stylet. The needle devised by Dr. Harry Jackson is equipped with a two-way valve and pet cock so that the spinal fluid may be withdrawn and observations of pressure may be made at the same time, thus making it possible to withdraw the amount of fluid desired to reduce the pressure to the amount wanted. In this connection it will be well to call attention to the presence or absence of a hydrostatic block of the spinal canal above the site of the spinal puncture. Here pressure is made upon the jugular vein on both sides (*Queckenstedt test*), with the result that egress of blood from the cranium is barred and the intracranial pressure is increased. This in turn will increase the pressure in the spinal canal which may be registered by the manometer *unless* a complete block has occurred above the lumbar puncture needle. As a control of this test, in cases where no increase of pressure is recorded after pressure upon the jugular vein, pressure upon the lower part of the abdomen by increasing the intraperitoneal pressure and in consequence the communications to the lower part of the spinal cord, should cause an elevation of the pressure as registered by the manometer. The patient should rest for from twelve to twenty-four hours in the horizontal position after a spinal puncture. In the University of Michigan Department of Syphilology there was but one death in 13,000 spinal punctures.[1]

2. **Aspiration of the chest** is done either as a diagnostic or therapeutic procedure. In cases of suspected empyema an aspiration is done in order to determine the character of the fluid and its location. Moreover, in certain cases of empyema in children repeated aspiration of the chest may be useful as a therapeutic measure (Brennemann, *et al.*). In cases of tuberculosis with marked effusion in the pleural cavity it may be necessary to aspirate some of the fluid to facilitate respiration. Before the aspiration is done the chest wall is percussed with the patient seated in the upright position in order to determine the upper limit of the fluid level. *x*-Rays of the chest in the vertical and horizontal posi-

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[1] Wieder, L. M.: Amer. Jour. Med. Sci., 173, 854, June, 1927.

tions are very useful. This level may be marked upon the skin with ink or blue pencil as desired. The aspiration is best performed with the patient seated and with the arm well forward. Where this is not possible, the aspiration may be done with the patient lying on his side at the edge of the bed. An area of about 10 inches square is painted with tincture of iodine and, if possible, draped with sterile towels. A small wheal is made in the skin with the local anesthesia, at the site of the aspiration. The site of election of aspiration is just posterior to the posterior axillary line between two ribs and a little toward the superior surface of the lower rib. This latter precaution is taken in order to avoid injuring the intercostal artery and nerve. It is generally wise to infiltrate the subcutaneous tissue beneath the wheal down to the pleura with local anesthetic. The aspirating needle is firmly grasped and introduced through the skin. In forcing it through the chest wall care must be taken that it does not suddenly plunge into the pleura cavity when the chest wall has been penetrated and thus injure the lung parenchyma. For diagnostic purposes a little syringe will first have been attached to the aspirating needle and the desired amount of the fluid or pus is aspirated and placed in a sterile test-tube. Care must be taken not to permit the entrance of air through the aspirating needle, because of the possibility of causing a collapse of the lung, in cases where the needle enters the free pleural cavity. In cases where it is desired to remove a large quantity of fluid this may be done either by using two alternating Luer syringes which quickly are attached to the aspirating needle so as to minimize the likelihood of air entrance, or by a negative pressure suction apparatus. A good example of the latter is the Potain aspiration apparatus (Fig. 149). When this apparatus is used a large flask or gallon bottle, which previously has been sterilized, is employed. The two-way connection is inserted tightly into the mouth of the bottle and the connection which is to communicate with the chest is shut off by turning the valve. By pumping with the aspirator through the other connection a negative pressure is created in the bottle. When this has been done the distal valve is shut off. When the aspirating needle or trocar has been introduced into the chest cavity, and the obturator has been withdrawn, the proximal connection from the bottle is made fast to the needle. The proximal valve is now opened and the fluid in the chest cavity will quickly flow into the bottle. If necessary the degree of negative pressure may be increased or decreased as desired. After the withdrawal of the aspiration needle it will be wise to seal the wound with a drop of collodion.

3. **Paracentesis abdominis** is done for the purpose of the removal

of the excessive quantities of ascitic fluid. Ascites is often found in intra-abdominal malignant disease and in cases of cardiorenal decompensation. It may be present in so great an amount that respiration is embarrassed and paracentesis will become imperative. The procedure is without danger except in those cases, such as tuberculosis peritonitis, where one might suspect that loops of bowel are adherent to the abdominal wall at the site of the aspiration. The aspiration is generally best performed with the patient seated in a chair and the trocar is inserted low down, 2 to 4 inches below umbilicus, in the midline of the abdominal wall. The bladder should be empty. A greatly distended bladder may be confused with ascites, and this doubt should be ruled out even if catheterization be necessary. It is improper to aspirate an ovarian cyst and this condition should be ruled out, if possible, in making the diagnosis. The skin is painted with iodine and as much as is possible is draped with sterile towels. The skin and underlying tissues are infiltrated at the puncture site with local anesthesia. The trocar being of rather large caliber, it is generally better to make a $\frac{1}{8}$- to $\frac{1}{4}$-inch incision before introducing it. It is important not to insert the trocar through the abdominal wall any more than is necessary to penetrate the peritoneum. If the intestines or omentum are swept up against the inside open end of the cannula, the flow of fluid will stop even if a large quantity of fluid still be present in the abdomen. Change of position or temporary insertion of the mandarin will generally remedy this difficulty. It is advisable not to withdraw the fluid too rapidly because of the likelihood of syncope. The patient's pulse should be watched carefully throughout the procedure as it may be impossible to withdraw the entire amount of fluid. Fontaine[1] has devised an improved cannula and trocar for use in paracentesis abdominis. This writer has used an Ochsner gall-bladder cannula with two trocars, one sharp pointed and the other blunt pointed. The cannula with the sharp-pointed trocar is introduced into the abdominal cavity. As soon as the fluid appears in the cannula, the sharp-pointed trocar is withdrawn, and the blunt-pointed trocar is placed in the cannula, screwed in place, and drawn out far enough to permit free drainage. In addition to the opening at the end of the cannula Fontaine has added four lateral openings at intervals at the lower end (Fig. 417). Neuhof and Cohen[2] recommend *abdominal puncture for the diagnosis of acute intraperitoneal disease* by means of a spinal puncture needle and a 20-c.c. syringe. Only a few drops of "fluid may be obtained, but this is often sufficient for a diagnosis. The theoretical danger of penetrating a loop should not deter the surgeon from taking advantage of this procedure, but it is not safe in the subacute or chronic case in which a loop of bowel might be adherent. A negative puncture has not been considered conclusive, and if the symptoms justify surgical intervention, such a finding has been disregarded. A positive puncture has prevented operation in a number of cases in which it would otherwise have been employed. A careful bacterial and cytological examination of the fluid obtained is as important as the finding of the fluid."

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[1] Fontaine, B. W.: Jour. Amer. Med. Assoc., April 18, 1925.

[2] Neuhof, H., and Cohen, I.: Ann. Surg., 1926, 83, 454.

In a group of traumatic cases the presence of blood or fluid as indicated by puncture was proved by subsequent laparotomy. In a group of cases of pneumococcus and streptococcus peritonitis the discovery of the organism on abdominal puncture prevented an unnecessary operation. The finding of fluid the color of beef juice and containing polynuclear leukocytes but no bacteria has decided the diagnosis of acute pancreatitis and the withholding of operation.

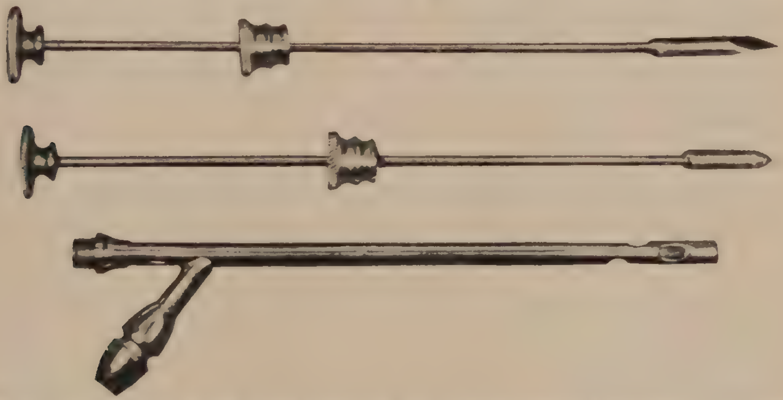

Fig. 417.—Improved cannula and trocar for use in paracentesis abdominis. (Fontaine, B. W., Jour. Amer. Med. Assoc., April 18, 1925.)

4. **Incision of the Tympanic Membrane (Paracentesis).** (See p. 183.)—This procedure is performed both as a curative and diagnostic measure in the inflammatory aural infections. The paracentesis is proceeded by a sterilization of the external auditory meatus by irrigation with warm solution of mercuric bichloride 1 : 4000. The outer portions of the external meatus and ear may be cleansed with alcohol. In certain cases anesthesia may be omitted, but because this operation is extremely painful some type of anesthesia is generally necessary. Gray[1] fills the canal with a warm aniline cocaine solution of the following formula:

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[1] Gray: Brit. Med. Jour., April, 1900, quoted by Barnhill and Wales, Modern Otology.

Cocaine cryst.	gr. xii–xxiv
Anilin oil	dram j
Absolute alcohol	dram j

A 5 to 10 per cent. solution of phenol in glycerin is useful, but requires a longer time to bring about anesthesia. Nitrous oxide or ethylene to bring about a general anesthesia is the method of choice. It is desirable, if possible, to have the patient seated upright during the administration of such an anesthesia, so as to present as normal relationships of the quadrants of the membrana tympani as is usually seen. Through the largest speculum that the external auditory meatus will accommodate a thin paracentesis knife is introduced. The most important point in the choice of an incision is the avoidance of the attachment of the auditory ossicle. The incision is generally made in one of the lower quadrants of the membrane, but in certain cases a superior quadrant will have to be incised. (See Fig. 90.) After the paracentesis has been performed the external auditory meatus should be loosely packed with sterile cotton to absorb the discharge.

5. **Infusion** is the term applied to the introduction of various fluids into a vein. The introduction of *intravenous medication* is, in reality, a small infusion, and the same technic should be observed. It is used under a wide variety of conditions, but particularly in shock, when normal saline, Ringer's solution, or dextrose-Ringer's solution will be employed. The usual method is to place the patient's arm out to the side on an armboard and to apply a tourniquet 3 or 4 inches above the elbow, just tight enough to obstruct the venous circulation. The blood-pressure machine is preferable as a tourniquet. The skin of the anterior surface of the elbow is painted with iodine and washed off with alcohol. The patient is instructed to open and close his hand several times so as to distend with blood, as much as possible, the veins of the arm. The needle which is connected by rubber tubing to the flask containing the desired solution at body temperature is now inserted into the vein, first taking pains to allow a little of the fluid to run out of the needle to insure the absence of air. To facilitate the introduction of the needle in the vein a 2-c.c. Luer syringe with side connection is extremely valuable. By withdrawing the piston of this syringe one may definitely ascertain whether or not he is in the vein, as the blood will then flow back into the syringe. As the piston is further withdrawn communication will be established between the vein and the side connection, and the effusion fluid which is under pressure will begin to flow into the vein (Fig. 418). At this point, of course, the tourniquet will be removed. The solution must not be allowed to flow in too rapidly because of the

increased pressure of the right side of the heart. Occasionally it will be necessary to infiltrate the skin with local anesthesia, and to cut down upon the vein, and to insert into it and tie in place a small cannula. (See method employed in blood transfusions.) Matas has extended this procedure so as to permit a continuous drip infusion for hours at a time (*venoclysis*), a method, however, which has some danger because of the possibility of thrombus and embolus formation at the site of the cannula, and because of the discomfort incident to keeping the arm quiet so long.

6. **Hypodermoclysis** is a term applied to the subcutaneous administration of large quantities of fluid. Saline and Ringer's solutions are the fluids generally employed: dextrose-Ringer's solution is more painful, but is indicated where there is definite caloric requirement. Hypodermoclysis is indicated in all cases of traumatic or postoperative shock, and in cases of hemorrhage. Moreover, it is freely utilized in grave infections, as peritonitis. Here 3000 or 4000 c.c. may be given in twenty-four hours. The usual place to inject the fluid is into and beneath the male and female breast (Fig. 419). The anterior surface of the thighs is equally good and is probably less painful. Where repeated hypodermoclyses are necessary, the sites of injection should be varied. In the urgency of the circumstances under which a hypodermoclysis often is given, attention to the necessity of asepsis is often relaxed. Subsequent abscesses at the sites of the injection are regrettable and

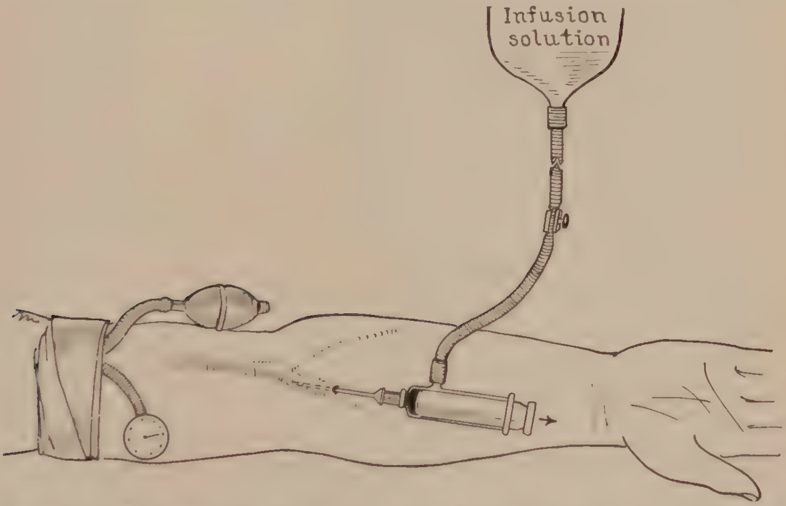

Fig. 418.—Side connection syringe for use in giving an infusion. As the piston of the syringe is withdrawn, blood from the vein enters until the piston is drawn past the side connection, when the infusion solution starts to flow into the vein.

often serious complications. The skin for an area of 5 inches about the site of injection is carefully painted with iodine. A sterile towel is placed over the upper abdomen. At the point of injection a skin wheal with local anesthesia will greatly decrease the patient's discomfort. In young children, or in restless or delirious patients, it is important that the needles be well guarded that they will not pull out or be contaminated. The fluid must be observed to be flowing freely through the needles before they are inserted and the apparatus must be free of air. The apparatus is equipped with two needles (Fig. 420), one of which is used for each thigh or breast. It will be well to introduce the needles for a distance of about 2 inches and from time to time to vary that position by withdrawing them 1 or 2 inches and reinserting them in a different direction. Too rapid distention of the tissues with solution is extremely painful, and the best procedure generally is to delegate to the nurse or attendant the control of the rate of flow. This is done by setting a screw pinch-cock on the rubber tubing at such a degree of tension as will be most comfortable to the patient. From time to time it is desirable to shut off the flow altogether, and to wait until some of the fluid has been absorbed before proceeding. Over a period of one to two hours 1500 to 3000 c.c. of solution may readily be introduced subcutaneously. A practical word of warning may be directed toward the insurance that the rubber tubing and connection are all in good working order. It is not uncommonly possible to have the repeated sterilization by the autoclave destroy the elasticity of the rubber and cause leaky connections, which are only discovered when the apparatus is being

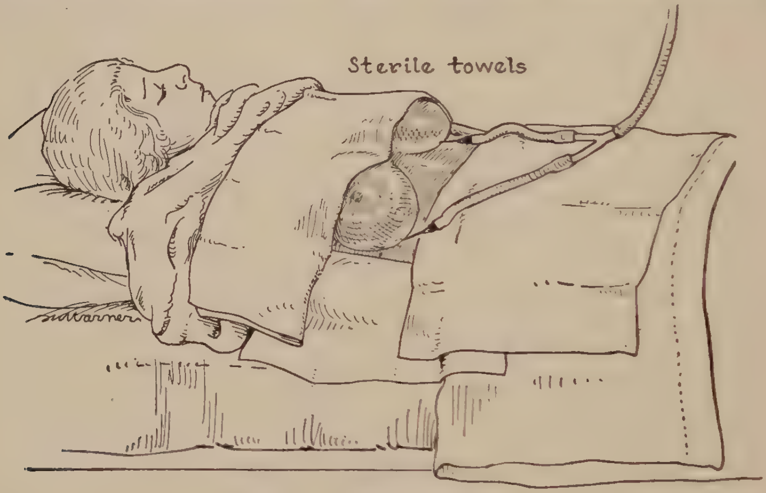

Fig. 419.—Hypodermoclysis.

used. Gentle massage, by the nurse, of the distended tissues will facilitate absorption, and will give comfort. Kolodny[1] has observed that infusion into the cellular tissue under the pectoral muscles leads to a marked increase in the frequency of the respiratory excursions and later to a fast pulse. When there is pain due to wounds of the upper abdomen, expectoration, respiration, and ventilation of the lungs are insufficient. The breathing is more thoracic than abdominal, being shallower and more rapid. In these cases hypodermoclysis of the chest wall is a further embarrassment to the chest movements. Kolodny prefers the giving of the hypodermoclysis in the outer aspects of the thighs. The puncture wounds are closed with collodion.

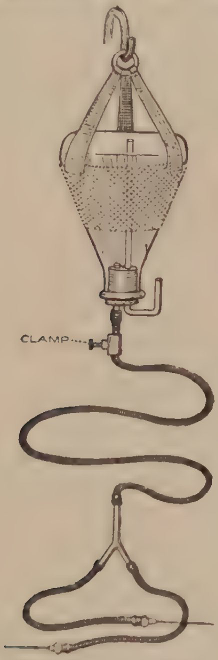

Fig. 420.—Apparatus for hypodermoclysis. (Kanavel, A. B., and Koch, S. L., Bulletin of the American College of Surgeons, 11, 3, July, 1927.)

7. **Vaccination.**—In vaccination for smallpox the site of the vaccination is carefully scrubbed with soap and water. It is then washed with alcohol, and the skin is allowed to dry thoroughly. The glass virus tube is then broken under sterile precautions and a few drops of the virus are forced out on the skin by means of the small rubber bulb which is provided. A sterile cambric needle is then drawn downward three or four times so as to produce three or four parallel scratches in the

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[1] Kolodny, A.: Jour. Amer. Med. Assoc., 1925, 84, 810.

skin. The same process may be repeated crosswise. Only the superficial epithelium should be traumatized, and the wounds should not be of such depth as to cause bleeding. The vaccinated area is now allowed to dry and a protective shield is fastened to the arm by adhesive plaster in such a manner that the site of the vaccination is not touched. If the vaccination "takes," a tender indurated ulcer will develop in a few days. There may be considerable discharge. The wound should be kept scrupulously clean and protected by sterile dressing or by vaccination shields. Occasionally a severe cellulitis will develop which will require hot boric fomentations and other appropriate treatment.

8. **Intubation** is the process by which a hard-rubber tube is introduced into an edematous and occluded larynx through the glottis. It is generally done in cases of laryngeal diphtheria, where the larynx has become so swollen as to threaten asphyxiation. Various types of instruments have been devised to facilitate the introduction of the intubation tube. The patient generally is wrapped in a sheet and a mouth-gag is inserted to hold the jaws open. The operator's left finger is introduced into the mouth in the median line and as far as the epiglottis, which it lifts up and holds out of the way. The operator's right hand introduces the intubation tube and its carrier into the mouth and carefully curves it around the base of the tongue, escaping the elevated glottis, to introduce it into the larynx. The obturator is then withdrawn, and the silk thread which is fastened to the intubation tube is anchored by adhesive plaster to the outside of the cheek, or brought around the neck. It may be useful to draw the tongue forward in the midline.

9. **Tracheotomy** is the operation of making an opening into the trachea to insure respiration in cases where the trachea and larynx have been blocked above. A tracheotomy tube is generally introduced into the opening. The operation is indicated in diphtheria, croup, edema of the glottis, and in cases where foreign bodies are lodged in the upper trachea. Certain traumata of the base of the tongue as well as laryngeal fractures may demand it. It is also indicated in cases where intubation fails. Cases are on record where urgent tracheotomy has been done with a penknife and hairpin retractors. Where urgent dyspnea or asphyxiation is threatening it is better to proceed without proper instruments than to delay indefinitely until they have been obtained. An urgent tracheotomy may be performed as follows: The patient is placed upon the table, one end of which is elevated so that the head is well below the body. The purpose of this is to prevent blood from running down into the trachea. In the case of a child the hands are wrapped to

the side in a sheet, with the head in full extension. The cricoid cartilage is drawn downward (away from the sternum) and an incision is made about 1 inch to $1\frac{1}{2}$ inches below the cricoid cartilage. Two or three tracheal rings are incised. There is a marked tendency oftentimes for the tracheal rings to collapse because of the suction exerted by the inspiratory efforts. A useful rough method of maintaining the tracheal opening is the introduction of two bent hairpin retractors on each side of the incision.

When the operation may be done more deliberately, general anesthesia is usually desirable. The skin is carefully prepared with iodine and alcohol and properly draped. The position of the patient is the same as that described above. A good light is essential. A tracheotomy set of various sized tubes should be at hand. The best type of tube is the curved one with inner and removable second tube. The operation may be performed at different levels. If above the level of the middle of the thyroid isthmus it is termed a high tracheotomy. A low tracheotomy is below the midlevel of the thyroid isthmus. High tracheotomy is more easily performed, but low tracheotomy occasionally is necessary in certain cases of foreign bodies. The skin is opened in the midline by an incision from the level of the cricoid to an inch or $1\frac{1}{2}$ inches below. Hemorrhage is controlled by clamp and ligature. By blunt dissection the trachea is exposed, taking care to retract to each side the overlying muscles. The deep cervical fascia is cut through and the thyroid isthmus retracted downward (in the case of high tracheotomy). A tenaculum hook is fastened into the cricoid cartilage and held so as to steady the trachea. Two or three rings of the trachea are then cut through by a downward thrust. If a membrane is present in the trachea it also must be incised. The blood and mucus will then be coughed out and wiped away, while the edges of the wound in the trachea are held open. The trachea is swabbed out and a tracheotomy tube is inserted. The tube is held in place by tapes which are passed around the neck and attached to the tube flanges. It may be necessary to ligate the isthmus. After tracheotomy the patient must be kept in a room in which the air is well moistened. The inner cannula must be cleansed with alkaline solution as often as is necessary to insure its patency.

10. **Skin-grafting** is indicated for the covering of large raw surfaces, for the shortening of time of morbidity, and the minimizing of deep scar formation. Three types of grafts are generally employed: The Thiersch graft or the thin graft, the small full-thickness or Reverdin graft, or the free full thickness graft which may be of the detached, pedicle,

or tubular variety. The more complicated pedicle and some of the tubular grafts are problems of major plastic surgery.

Of first importance in skin-grafting is the proper preparation of soil for the graft. The presence of any degree of infection is a certain invitation to failure. A purulent discharge from the wound surface or the presence of little furuncles in the skin in the neighborhood of the wound are contra-indications to skin-grafting. These infections should all be cleared up by the use of Carrel-Dakin treatment or by hot boric fomentations before skin-grafting is attempted. The skin to be grafted must be taken from the same individual. Heterogenous grafts are practically always unsuccessful. Where a heterogenous graft is to be attempted, it should only be done where the graft donor is in the same blood grouping as the graft recipient. Bertocchi[1] performed sixty-five experiments in grafting skin fixed in formalin or alcohol. "The author states that grafts of skin fixed in the manner described should be tried in cases in which autoplastic grafting is impossible, for even if there is not a true growth of the grafted skin gradual reconstruction of skin from the host's tissues occurs under the guidance of the fibers of the fixed tissue and undoubtedly with the use of some of the constituents of this tissue."

Thiersch Grafts.—It is generally desirable to employ general anesthesia for skin-grafting. The skin is prepared by washing with alcohol and then with a sterile saline solution to remove all traces of the alcohol. The wound to be grafted is irrigated with sterile saline. The grafts will take on granulation tissue, but if it be too abundant, it may be curetted off and hot compresses applied until all bleeding has ceased. The skin from which the grafts are to be taken is held tense by traction in opposite directions by flat objects, such as rulers. The grafts are then removed by a razor or skin-grafting knife. This is done by a sawing motion, great care being taken not to cut through the entire thickness of the skin. A thin film of the upper epidermis only is removed. The pieces should be as large as possible. The razor or knife on which the graft lies in a wrinkled-up state is now transferred to the instrument table and the grafts are carefully teased off the knife by the points of cambric needles onto glass slides which have been moistened with saline solution. In this way the number of grafts are removed which are thought to be sufficient to cover the wound and are placed on glass slides. By means of the cambric needles the grafts are then slid off the glass slides onto the surface of the granulation tissue. It is important to have the graft lie smooth and flat upon the wound. No harm is done if the grafts overlap. Any curling up of the edges should be corrected carefully. Where the grafts are very large some authorities recommend the making of small holes through the grafts for the escape of secretion. Blair, of St. Louis, attached his grafts, where possible, to the wound margins by a sort of basting stitch. This is introduced down into the graft and up through the normal skin. It is extremely important to try to prevent the lateral slipping of the graft by any movements of the overlying dressing. The grafts are then covered by several layers of salvaged gauze which has been thoroughly impregnated with a solution of 3 per cent. xeroform in vaseline. The writer has found it useful to insert a number of interrupted sutures through the xeroform gauze to the intact skin surrounding the wound. This is a great preventative against side slipping of the graft. An abundant quantity of gauze is now placed over the xeroform gauze and the whole is firmly bandaged in place. Pressure upon the grafts seems to facilitate their "taking." Coller[1] has advised the use of paraffin as a primary dressing for skin-grafts. "Flexible paraffin of the type used in treating burns is applied by means of an atomizer, the entire grafted area and a margin of skin at its periphery being covered with a layer at least 1.5 mm. thick. The entire paraffined grafted area is then covered with strips of gutta percha, each an inch wide and as long as the wound, and over these is placed a dressing of fluff gauze. A retention bandage is applied so that it produces moderate pressure. A coating of paraffin is applied also to the area from which the grafts were removed.

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[1] Bertocchi, A.: Arch. ital. di chir., 1925, 11, 445.

"When the grafts are applied to a sterile fresh surface the dressing need not be taken down for at least five days, but in dealing with a granulating surface the first postoperative dressing is done on the third day. If the surface is dry and sterile, a similar dressing is applied and subsequent dressings are done every second day. If infection is believed to be present, the wound is cleaned with Dakin's solution, dried, and exposed to the air under a screen cradle during the day and covered with sterile petrolatum and gauze during the night, the use of paraffin being discontinued.

"The paraffin dressing is valuable because it fixes the graft at a time when a slip means disaster, its splinting effect insures the application of a correct amount of pressure without the danger of displacing the graft, and when the time arrives for its removal it comes away freely without any tendency to stick and loosen the graft."

The chief argument against the use of paraffin is that it seals the wound, causing the retention of secretion which will elevate the graft, but Coller has not found this true of paraffin as often as of other impervious substances.

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[1] Coller, F. A., Surg., Gyn., and Obst., 41, 221, 1925.

The first dressing is done on the third or fourth day, and great care is exercised in the removal of the xeroform gauze, which is carefully peeled back from one edge. The edges of any grafts which have adhered to the gauze are carefully snipped off or replaced. The portion of the gauze surrounding the interrupted sutures in the normal skin may be left in place and the fresh dressing of xeroform gauze may be anchored to this gauze by new sutures. After the grafts are a week or ten days old it will be wise to expose them to the air for several hours every day. The upper layers of the graft often scale off, but this does not interfere in any way with the usefulness of the graft. Westhues "cuts Thiersch grafts twice as thick as usual and then divides them into parallel strips 3 or 4 mm. wide. By means of an instrument similar to a Deschamps needle the strips are woven through the granulating surface. The grafts take in two or three days. The granulations on top of the portions of the strips that have been drawn under are then carefully removed so that the entire graft is freely exposed. With great rapidity the areas between the strips become covered with epithelium. It is emphasized that, during the first two days, dressings wet with salt solution should be applied to the transplants and should be changed at least twice a day."

Williams[1] observed a Thiersch graft which had been done thirty years previously. He noted that "sensation was only moderately impaired, but secretion and excretion were entirely lost, and for this function the graft was entirely dependent on the adjacent skin. . . . It would seem that a whole-thickness graft would be the method of choice in most instances, because more structures of the corium would persist and thus permit the function of the transplant more closely to approximate the normal."

The *Reverdin* or *small grafts* are obtained by lifting the skin up with the point of a cambric needle, and excising a small, round island about $\frac{1}{4}$ inch in diameter by means of a sharp scalpel or scissors. These small islands of skin are placed upon the previously prepared, clean granulations of the wound. The dressings are carried out in the same manner as those of Thiersch grafts.

McWilliams[2] has given us excellent advice in the use of free full-thickness grafts. This author "has found full-thickness skin-grafts more satisfactory than Thiersch grafts in that they do not ulcerate and contract, allowing shrinkage of the underlying tissue. Careful attention to details is necessary. By means of an inflatable rubber balloon devised by Ferris Smith definite even pressure can be maintained over the graft until new blood-vessels are formed connecting it to the underlying tissue.

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[1] Williams, G. A.: Arch. Surg., 16, 938, April, 1928.

[2] McWilliams, C. A.: Ann. Surg., 1926, 84, 237.

"Autografts are always chosen. Fresh sterile operative wounds and finely granulating (sterile) areas are equally successful as beds for the graft. Fresh fat and bones bare of periosteum are usually not suitable. Free full-thickness grafts should be used in areas where contractions are to be avoided, as about the eyes and joints. The fat should be removed from the graft with a knife. Pinching of the graft is to be avoided. In order to preserve normal tension so that the capillaries will remain open, the graft should be cut of exactly the same size as the area it is to cover. Perforations are not necessary. The graft should be sewed in carefully all about the edges with close, interrupted stitches in order to maintain normal tension, and an even firm pressure of 30 mm. should be applied upon it by means of an inflatable rubber balloon. Absolute immobilization is necessary for at least five days. There is no limit to the size of the grafts which may be successfully transplanted.

"Free full-thickness grafts are successful when applied to fresh muscle and fascia, including pericranium and periosteum, to bared sheaths of tendons, whether granulating or fresh, to palmar fascia, to fine clean granulating areas generally, except in the neck, and in the defects produced by the surgical removal of rodent ulcers." The marine sponges advocated by Sumner Koch are a valuable substitute for the inflatable rubber balloon.

Rope Grafts: Tubular Grafts.—The technic of rope grafts has been lucidly described by Lahey[1] of Boston. An abstract of Lahey's paper follows: "To form a rope or tubular graft a strip of skin is outlined by parallel incisions and elevated from its bed so that it forms a flat strip or ribbon attached only at its upper and lower ends. Its two cut edges are then brought together and sutured with the raw side inward to form a tube, except for a short distance at the bottom and top where the tubing would cause constriction and interfere with the blood-supply of the graft.

"The two cut edges of the bed from which the graft was removed are also approximated except for a short distance at the upper and lower ends where their approximation would interfere with the blood-supply of the graft. Sterile boric ointment strips are then placed over the wound beneath the tube to prevent the formation of crusts of dried blood and serum between the two suture lines.

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[1] Lahey, F. H.: Boston Med. and Surg. Jour., 1926, 194, 1.

"After from nine to twelve days, healing is usually complete, the wounds are dry, and the tube well nourished. Either end of the graft with an attached small segment of skin cut to the pattern required may then be transplanted to any point desired. A good blood-supply is obtained through the long-tubed pedicle.

"When the transferred end of the tube has united well with the area into which it has been grafted (after from ten to fourteen days) the tube is cut away at the point where a sufficient amount of skin has been transferred and the remaining tubed pedicle is split, reopened, and sutured back into its bed or cut off at its base and sacrificed.

"If it is impossible to obtain the amount of skin desired by transferring one end of the tube to the point into which the graft is to be inserted, one end may be transferred and inserted half the distance to the point desired and at the end of two weeks the base of the pedicle may be severed and transferred to the desired point, the original point of transfer serving as a pedicle.

"In the outlining of the graft the parallel incisions must be sufficiently far apart to make the strip wide enough to be formed into a tube without constriction. Constriction is indicated by blanching of the segment when the approximating sutures are tied.

"Care must be taken not to remove too much subcutaneous fat with the flap because if the quantity is too large it will fill the tube so full that its edges cannot be approximated or can be brought together only with tension. If the flap has not been made too narrow, difficulty in tubing may usually be overcome by cutting away a greater amount of the subcutaneous fat from the ribbon of skin to be tubed. A moderate amount of fat is a distinct advantage as it prevents the formation of a pocket for the accumulation of serum and gives the walls of the tube sufficient thickness to provide an adequate blood-supply.

"Careful measurements should be made of the distance between the point at which the graft is to be inserted and the point which is to serve as the base of the pedicle. The pedicle tube must hang loosely; tension may result in necrosis.

"To test the vascularity of the graft before transferring it a ligature is tied around the end to be transferred and another at the base, the point which is to be the pedicle, and after a minute or two the ligature at the pedicle or base is removed and the degree of flushing and the rapidity with which the flush descends the graft are noted. If a good red color appears and extends down the tube rapidly, a good blood-supply is assured. A similar procedure is used to determine the vascularity of the transplanted end when it is desired to cut the transplanted graft away from the pedicle.

"When the tube is to be sutured back in its bed after it is cut away from the transplanted flap it is split along its line of suture, its edges are undercut sharply, and its central cord of subcutaneous fat is trimmed out with the scissors to convert it again into a ribbon. The edges of the wound in which it is to be sutured are also sharply undercut to permit good approximation."

11. **Dilatation of the Sphincter Ani.**—The method of proper dilatation of the sphincter ani has been described previously (Chap. XVII.).

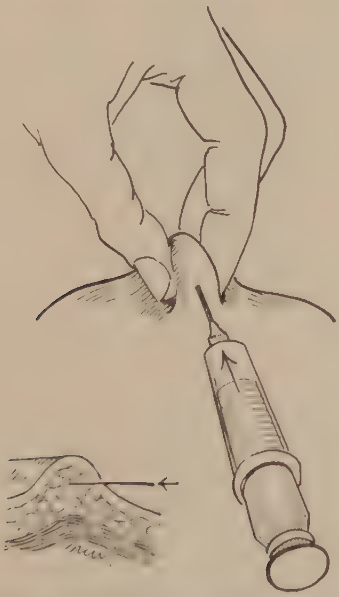

Fig. 421.—Administration of hypodermic medication. The skin is lifted up between the thumb and forefinger, and is gently pinched.

12. **Hypodermic Injections.**—The technic of the insertion of hypodermic injection is very simple. The skin is first cleansed by a pledget of gauze soaked in alcohol. The skin is pinched up between the thumb and forefinger under some slight pressure and a hypodermic needle is firmly and quickly passed through the skin into the subcutaneous tissue (Fig. 421). Care must be taken not to break off the needle in the subcutaneous tissues. This unfortunate accident has happened many times and it is often extremely difficult to find the needle. The hypodermic solution can be injected rapidly when the point of the needle is in the subcutaneous tissues. The point of the needle should not be

in the skin itself. Figure 422 shows the regions in which hypodermic injections should not be made.

13. **Phlebotomy** is the opening of a vein for the purpose of bleeding. It is done either by the placing of a needle in the vein itself or by the cutting of the vein. The introduction of the needle in the vein is accomplished in the same manner as is described under infusion, using the blood-pressure tourniquet to distend the vein. The vein itself is put under some tension so as to steady it and the needle is carefully passed through the skin and then guided by the sense of touch into the lumen of the vein itself. When the vein is to be opened by incision, the skin will first be infiltrated by local anesthesia.

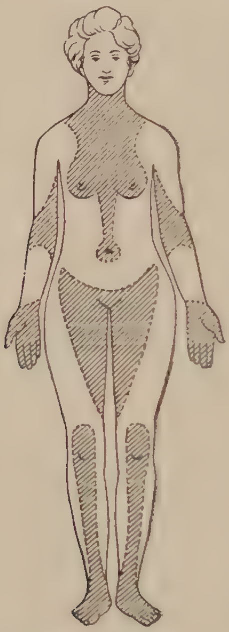

Fig. 422.—Areas of the body surface where a hypodermic should not be given (Maisonnet, "Petite Chirurgie").

14. **Blood Transfusion.**—The first requirement for blood transfusion is to obtain a donor whose blood is compatible with that of the recipient. To make sure of this the blood of each should be tested to establish in which group it falls. The blood of the donor must fall in a group which is compatible to that of the recipient. After a donor has been found whose blood is in the same group as the recipient, the bloods of the two individuals should be tested for compatibility before the transfusion is done. Dyke[1] says that in "the selection of a donor

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[1] Dyke, S. C.: Lancet, 1927, 28, 910.

for transfusion it is essential to test the recipient's serum against the red cells of the proposed donor. This should be carried out carefully and according to a standard technic. In addition, grouping tests on both recipient and donor are desirable, but little importance can be attached to them until we are more certain as to the constitution of the groups. The mere fact that a person is known to belong to Group IV can never justify the assumption that his blood will suit any and every recipient; matching tests are necessary for 'universal donors' as well as for others. However, as it is probable that the blood of the donors of Group IV will be compatible with the blood of more recipients than the blood of persons belonging to other groups, it is desirable to have persons of Group IV on the roster of a transfusion service. If transfusion is always preceded by matching, donors belonging to other groups may also be included." The tests should be made the same day as the transfusion. The importance of the compatibility test is evident from Cornils' study of 500 blood transfusions. In 5 per cent. of this author's cases the preliminary serological tests were found to be incorrect.

Blood grouping is carried out at the Evanston Hospital, in the laboratory of Dr. J. L. Williams, as follows:

1. Prepare two sterile test-tubes, one dry centrifuge tube, the other containing about 0.5 per cent. citrate in normal salt solution.

2. Collect the blood from the ear of the patient into each tube; about 0.5 c.c. in the centrifuge tube and enough in the other tube to fully color the citrate solution red.

3. Place in ice-box and allow blood in centrifuge to coagulate.

4. Loosen clot in centrifuge tube and centrifugalize. Centrifugalize the citrate solution at the same time.

5. With sterile pipet remove citrate solution from tube and replace it with sterile normal salt solution.

6. Repeat this process twice.

7. Remove salt solution and add enough more sterile salt solution to form suspension of proper consistency.

8. Remove with sterile pipet the serum from the other tube into small sterile test-tube.

9. On clean slides place two loopfuls of the known II and III serums, flaming the loop carefully between each loopful.

10. Place one loopful of the patient's cells into the serums already on the slides and mix gently. Then, picking up the slides, rotate slowly, thoroughly mixing the cells and serum. Tap slides to facilitate clumping.

11. As a check, place in a similar way on a clean slide two loopfuls of the patient's serum and combine with it the known fresh II and III cells. Rotate slide gently as above.

12. When agglutination occurs with the patient's
    cells and II serum only, the patient is in Group III
    cells and III serum only, the patient is in Group II
    cells and both II and III serum, the patient is in Group I
but when no agglutination occurs with the patient's cells and neither II nor III serum, the patient is in Group IV.

As a check:

When agglutination occurs with the patient's
  serum and II cells only, the patient is in Group III
  serum and III cells only, the patient is in Group II
  serum and II and III cells, the patient is in Group IV
  serum and II and III cells do not agglutinate, the patient is in Group I.

13. Results (diagrammatically):

	Cells			
	I	II	III	IV
I	0	0	0	0
II	–	0	–	0
III	–	–	0	0
IV	–	–	–	0

Moreover, it will be wise to be sure that the blood of the donor will give a negative Wassermann reaction.

In a review of the experiments in the transfusion of the blood of animals to man, Cruchet[1] concludes that the blood of the horse seems to be better tolerated than that of the sheep or the ox, that the blood must be given slowly and the animal from which it is taken must be healthy. The blood must be used immediately, and horse's blood should be diluted one-half to one-third with physiological serum. Adrenalin may be added to the mixture.

The indications for blood transfusion are numerous. In discussing these indications Rolleston[2] says that blood transfusions are of value to make good the deficiency of blood after acute hemorrhage, to increase the coagulability of the blood by supplying fibrogen, to make good a deficiency of red blood-cells, to furnish substances in which the blood is deficient, such as antibodies in acute infections and functionally active hemoglobin in carbon monoxide poisoning, to act upon the bone-marrow which is disordered, as in leukemia, to dilute toxins in toxemia, and to increase the bactericidal power of the blood through the action of leukocytes and the opsonic power of the serum. It is to be considered in acute anemia due to hemorrhage, chronic anemia due to repeated hemorrhage, hemorrhagic diseases and conditions, purpura hemorrhagica, postoperative shock, hemorrhagic diseases of the newborn, hemophilia, jaundice, pernicious anemia, anemias other than Addison's anemia, leukemia, acute septicemia, intoxications such as carbon monoxide poisoning, and debility. In reviewing 25 cases of blood transfusion done in septicemia and pyemia Keynes[1] found there was no benefit in 22 cases.

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[1] Cruchet, R.: Brit. Med. Jour., 1926, ii, 975.

[2] Rolleston, Sir H.: Brit. Med. Jour., 1926, ii, 969.

Transfusion may have a very great value in burn cases, especially after bleeding the patient. See chapter on Burns. It may be an aid to the metabolic toxemias of infancy (Carlton[2]). It has been recommended in children in cases of inanition, malnutrition, and secondary anemia from such causes as chronic gastro-intestinal infections, diarrhea, chronic bronchitis, and unresolved pneumonia (Brooks[3]) and even in erysipelas (Sidbury[4]).

Two general types of blood transfusion are in use. The first is the *whole-blood* method in which the untreated blood of the donor is transferred to the recipient. The second is the *citrate* method in which the blood of the donor is first treated with sodium citrate to prevent clotting before it is administered to the recipient. Most authorities agree that the whole-blood method is preferable wherever it is feasible. In this method there is less likelihood of reaction and it is possible that the blood itself has a more beneficial effect.

(a) Whole-blood Method.—For an interesting discussion of the clinical aspects in 1000 cases of transfusion of unmodified blood see Blain and Brines.[5] Whole blood may be given in a vein, intraperitoneally, and subcutaneously. In infants and very young children the subcutaneous method is in most general use. In this method typing and matching are unnecessary. According to Moore and Dennis[6] the optimum amount of blood for newly born and dehydrated infants is 50 c.c. per kilogram of body weight, or 5 per cent. The necessary percentage decreases with age. The blood should be given subcutaneously in the thighs and in the sides and front of the chest and abdomen.

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[1] Keynes, G.: Brit. Med. Jour., 1926, ii, 980.

[2] Carlton, C. H.: Lancet, 1926, 211, 850.

[3] Brooks, LeR.: California and Western Medicine, 1928, 28, 331.

[4] Sidbury, J. B.: Jour. Amer. Med. Assoc., 1927, 89, 855.

[5] Blain, A. W., and Brines, O. A.: Arch. Surg., 12, 140, January, 1926.

[6] Moore, C. U., and Dennis, H. G.: Northwestern Medicine, 1928, 27, 140.

Citration of the blood, using 10 c.c. of a 2 per cent. sodium citrate solution to each 90 c.c. of blood, permits ample time for injection (Moore and Dennis). The whole blood, however, probably has better therapeutic effects. In the intraperitoneal type of transfusion it is necessary to group the bloods and to match them, because some, at least, of the red blood-cells are absorbed unchanged. In describing the intraperitoneal blood transfusion in infancy and childhood Grulee[1] uses the syringe or gravity method. In the former method a 16-gage 1¼-inch needle is connected to a 100-c.c. syringe and 12 to 15 c.c. of sterile 2.5 per cent. sodium citrate solution are drawn into the syringe. Any air incident to this is expelled. The same needle which is filled with the citrate solution is then inserted into the selected vein of the donor, the syringe filled with blood to the 100 c.c. mark, and the syringe disconnected from the needle and placed on the sterile table. The second Luer syringe is fitted to this needle and another 100-c.c. of blood are withdrawn. As the first syringe of blood is withdrawn, the operator signifies to his assistant, at the proper time, to insert the 18-gage needle into the recipient's abdomen, which has been previously prepared. This needle is inserted in a posterior and cephalad direction, at a point about 1 inch below and to the right of the umbilicus. As soon as the operator places the first syringe of blood on the sterile table, the assistant picks it up, connects the syringe to the intraperitoneal needle, and injects the blood slowly into the intraperitoneal cavity, simultaneous with the filling of the second syringe by the operator. The syringes are then interchanged and the second 100 c.c. of blood administered, etc., until the desired amount is given (Grulee). The gravity method is similar save that a gravity tube is used and blood is allowed to flow into the peritoneal cavity by gravity. Grulee says that there is practically no danger of puncture of a hollow viscus if ordinary precautions are used. The intestines, unless adherent to the abdominal wall at the point of injection, will slip away from the point of the needle, and it is practically impossible to transfix them. Adhesions are exceedingly rare in infants and young children. "Careful examination of the abdomen should be made to be sure that the liver or spleen is not in the region chosen for puncture, and also one should be careful that an overdistended bladder does not extend above the symphysis. The location of choice, of course, is in either the right or left lower quadrant" (Grulee). In this connection the experiments of Florey and Witts[2] are of interest. In experiments performed on dogs under general anesthesia these authors "placed a cannula in the thoracic duct and determined the rate of entrance of the red blood-cells into the lymph from the peritoneal cavity." It was found that the flow of lymph from the duct was increased by respiratory movements and massage of the abdomen. Previous experiments had shown that blood from a different species was promptly hemolyzed, and in the case of injected sheep's blood, although the lymph became a bright transparent red, the red cell count never exceeded 18,000 per cubic centimeter.

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[1] Grulee, Clifford G.: Southern Med. Jour., 20, 1, January, 1927.

[2] Florey, H., and Witts, L. J.: Lancet, 1928, 214, 1323.

After the injection of blood into the peritoneal cavity, no constant change in the rate of the lymph flow occurred, but red blood-cells began to appear in the lymph after from twenty to forty minutes. The rate of flow of lymph and the number of cells depended upon the rate of respiration. In six hours only one-sixteenth of the number of red blood-cells injected into the peritoneal cavity were absorbed at best. However, the count in the remaining blood in the peritoneal cavity increased from 7,000,000 to 9,000,000 per cubic centimeter, demonstrating the easy absorption of fluid elements of the blood. Blood remaining within the peritoneal cavity is a dangerous source of infection. In some of the animals it caused septic peritonitis. Undue pressure upon the abdomen and contractions of the hollow viscera promote the absorption of toxic elements when infection of the peritoneum occurs and may perhaps be factors involved in the spread of malignant disease.

The authors conclude that "intraperitoneal transfusion is without great benefit in the treatment of shock and collapse, but may possibly be of value in the treatment of certain types of chronic anemia." Grulee[1] reports 12 cases of infants suffering from von Jaksch's anemia in almost all of which the immediate results are good following intraperitoneal blood transfusion. In infants the longitudinal sinus is available for transfusion.

Perhaps the best method of performing a whole-blood intravenous transfusion is by the use of the *Scannell apparatus*. This consists of a three-way valve connected to three rubber tubes and to a 20-c.c. specially constructed syringe. The rubber tubes go to the donor, the recipient, and to a basin of saline solution. The patient and donor are placed upon parallel operating tables with the arms to be used extended on arm-boards, so that the wrists of the two individuals lie side by side (Fig. 423). The arms of the recipient and donor are prepared with iodine and alcohol and properly draped. A blood-pressure apparatus is placed on the upper arm of the donor and used as a venous tourniquet. When the blood is withdrawn from the donor the blood-pressure apparatus is pumped up to a pressure of about 60 mg. mercury. A simple elastic tourniquet is placed upon the arm of the recipient to distend his veins to facilitate their location. It is removed when the blood is injected. It is very important at this stage to be sure that all the tubing and needles are filled to overflowing with the saline solution. Under local anesthesia a 1-inch longitudinal incision is now made over the

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[1] Grulee, Clifford G.: New York State Jour. Med., 1926, 26, 921.

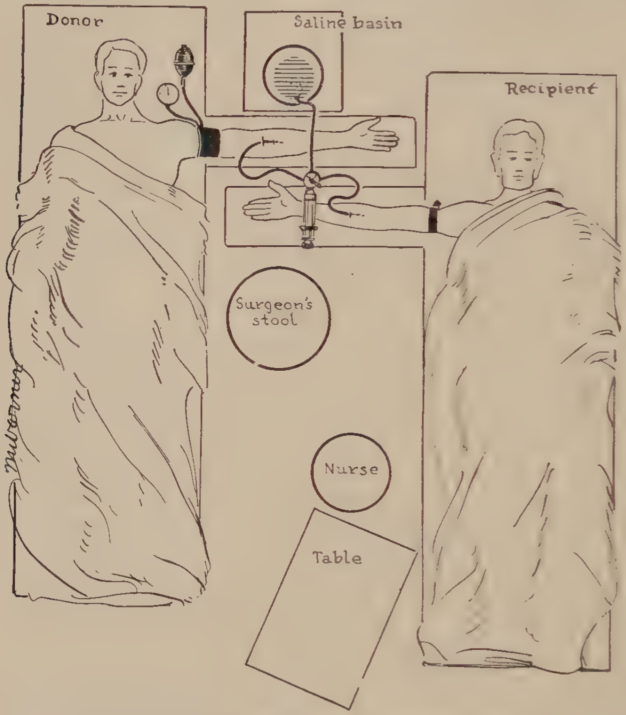

Fig. 423.—Set-up for whole-blood transfusion. (See text.)

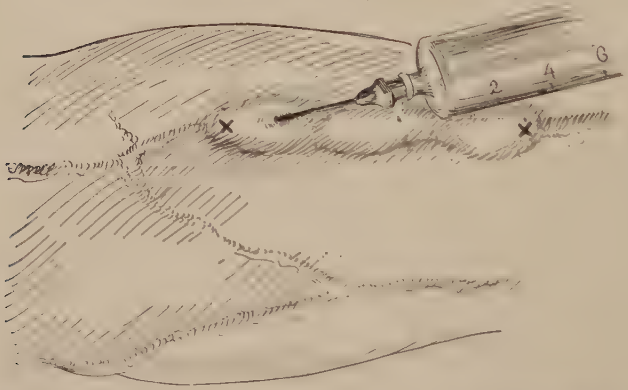

Fig. 424.—Infiltration of vein of recipient preparatory to cutting down upon it.

the vein of the recipient and by blunt dissection the vein is exposed (Fig. 424). By means of an aneurysm needle two catgut ligatures are passed beneath the vein and are spread apart for a distance of $\frac{1}{2}$ inch (Fig. 425). The distal ligature is tied in a square knot and the ends cut off. The proximal ligature is loosely tied once and the ends placed out of the way. The vein is then lifted up by the proximal ligature or by a single mosquito artery forceps and a small transverse incision into the vein is made by means of a fine pointed scissors (Fig. 426). Entrance into the lumen of the vein will be apparent by the outpouring of blood which may, however, be controlled by traction on the ligature. The beaded end of the cannula is now carefully inserted proximalward into

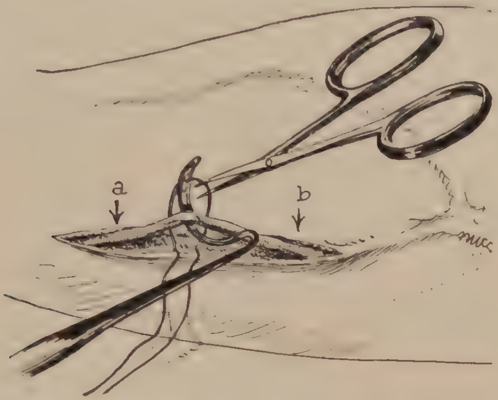

Fig. 425.—Isolation of the recipient's vein. Vein tied off at *a* and ligature knotted once at *b*.

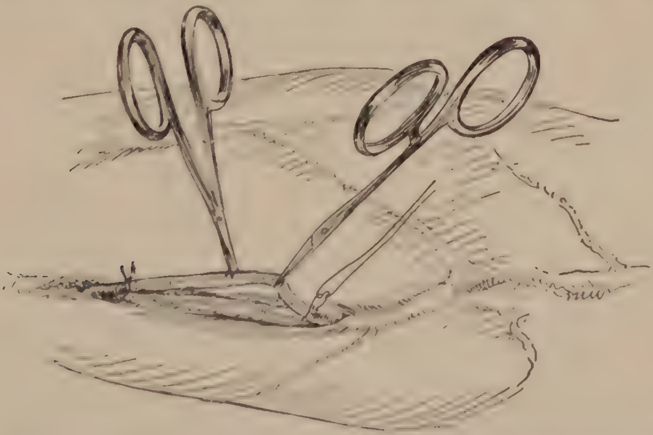

Fig. 426.—Traction on vein by hemostat or ligature. Small transverse cut in vein with sharp-pointed scissors.

and well up the vein of the recipient and the loose ligature is tightened up but not knotted, so as to insure the cannula remaining in place (Fig. 427). The tourniquet is removed from the arm of the recipient. The distal or outgoing tube from the three-way connection has been previously connected to the cannula in the vein of the recipient. While an assistant slowly injects a very small quantity of saline solution into the vein of the recipient, the operator quickly prepares to insert the needle into the vein of the donor. If desired a wheal of local anesthesia is placed in the skin of the donor over the vein which has been selected, and a small incision may be made in this wheal (Fig. 428). This generally is unnecessary. The blood transfusion needle is carefully inserted into the vein which has been previously distended by the blood-pressure constrictor with the point of the needle toward the hand. McNealy[1] believes that better results are obtained if the needle is pointed toward the shoulder. It will occasionally be necessary to cut down on the vein of the donor and to insert a cannula. When the needle has entered the vein of the donor blood will flow out to the end beside the edges of the obturator. The flange of the donor needle

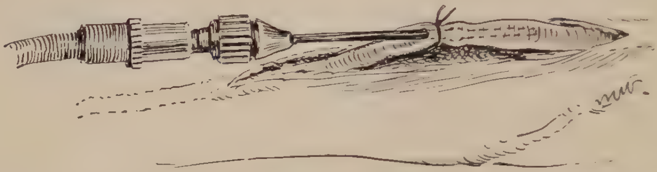

Fig. 427.—Cannula in vein of recipient. The ligature is knotted only once.

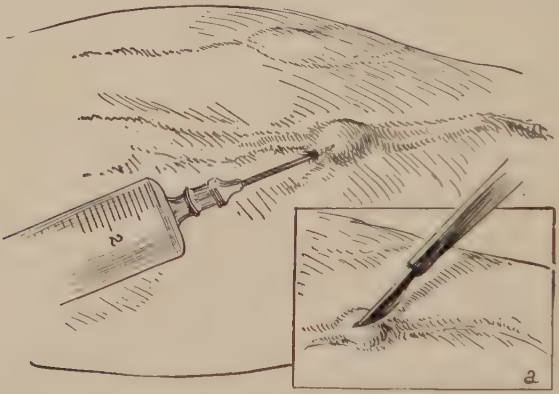

Fig. 428.—Infiltration and incision of skin of donor. This step may often be omitted and the needle inserted directly into the vein. *a*, Small incision over vein of donor.

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[1] McNealy, R. W.: Personal communication.

may now be fixed to the skin by transfixing the skin and the holes of the flange by a single cambric needle (Fig. 429). The intake tube of the three-way connection is now connected to the needle in the donor's vein. The blood-pressure machine on the arm of the donor is maintained at 60 mg. and the latter is instructed to open and close the hand from time to time. A nurse is instructed to note on a piece of paper the exact quantities of blood injected, so one may keep track of the total. The three-way valve is first set so that the withdrawal of the piston from the syringe will fill the latter with the donor's blood (Fig. 430). When the 20-c.c. syringe has been filled with the donor's blood, the three-way valve is quickly moved with the thumb so as to establish a communication between the syringe and the vein of the recipient. The piston of the syringe is now driven home and thus will 20 c.c. of the donor's blood be delivered to the recipient. After two or three syringefuls of blood have been delivered in this manner, the three-way syringe is set so that the tube of the saline basin is connected to the syringe and the syringe is filled with saline. The syringe is then disconnected and passed to a nurse who in turn passes the operator a fresh

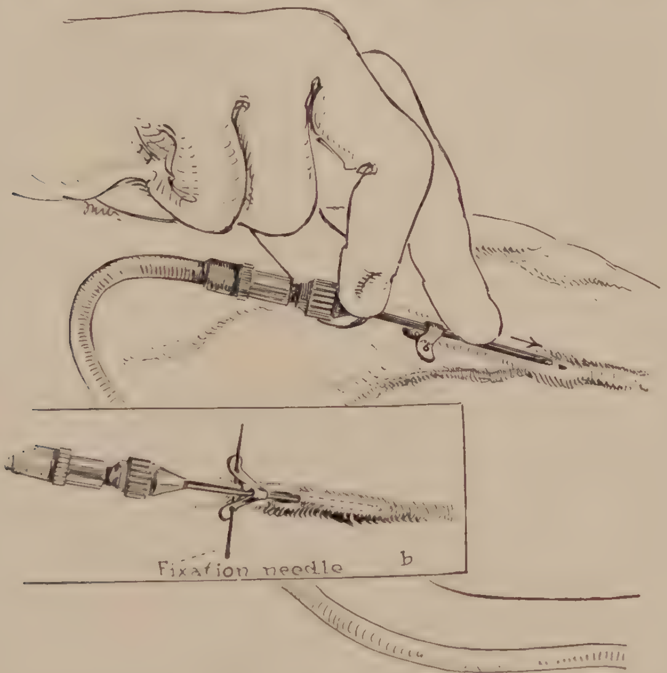

Fig. 429.—Introduction of needle into vein of donor. *b*, Donor needle made secure by transfixion through skin and flange.

syringe which is attached to the valve. While the surgeon is proceeding with the transfusion the nurse will thoroughly cleanse the used syringe and have it ready. Generally two or three syringefuls of blood may be delivered before it is necessary to change syringes. It is sometimes necessary to change the syringe after one syringeful of blood has been delivered if there is any tendency whatsoever of catching of the piston to the walls of the syringe. If for any reason the blood seems to flow slowly, it is permissible to pass a small quantity of saline into the veins of either the donor or the recipient, which easily may be done by the proper manipulation of the three-way valve. Five hundred c.c. is the usual quantity of blood given at a blood transfusion.

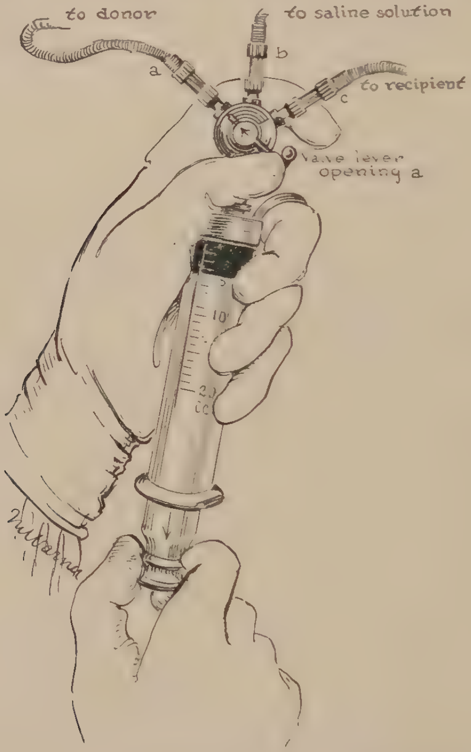

Fig. 430.—Whole-blood transfusion by the Scannell apparatus.

Another method of whole-blood transfusion which is in common use is the *Lindemann method*. In this method 50-c.c. Luer syringes are used. The syringe is attached to the needle in the vein of the donor and 50 c.c. of whole blood are withdrawn. The syringe is then detached from the needle without removing the latter from the vein and is attached to the syringe or cannula which has been placed in the recipient's vein. While the blood is injected into the vein of the recipient, a second syringe has been attached to the donor's needle and 50 c.c. more of blood are being withdrawn at the same time. When the blood has been injected into the vein of the recipient the syringe is detached from the needle and handed to a nurse, who will thoroughly wash the syringe and piston with saline solution and see that it is in proper working order. A freshly cleansed syringe is always used for the withdrawal of blood from the vein of the donor. Four to six syringes are used in this method. Clotting is more liable to occur in this method than in the Scannell method.

Several other methods of whole-blood transfusion have been devised, including the Unger method and the method of Head.[1] In the latter method a specially designed valveless pump keeps the blood in motion. Direct anastomosis between the artery of the donor and the vein of the recipient is no longer employed.

Brines[2] has described his modification of the Unger apparatus and advances very convincing claims for it. In order to prevent the contact of the blood with the air, which he holds responsible for posttransfusion reactions, Strauss[3] has perfected the syringe-cannula needle method of direct transfusion. The apparatus for this method consists of three 100-c.c. Luer syringes, which usually hold about 150 c.c. of blood, a short piece of rubber tubing, and 2 cannula needles, one for the donor and one for the recipient. The cannula needle contains an obturator which is beveled at the end like a spinal needle and is sharp enough to pierce the skin and vein with ease. Midway down the cannula needle is a shoulder with a perforation which will admit a cambric needle. The technic of inserting the cannula is as follows: A blood-pressure apparatus or a small rubber constrictor is set on the recipient's arm and the pressure raised to from 60 to 80 mm. Hg. The recipient then contracts the muscles of the forearm to distend the vein and a cambric needle is inserted transversely to the long axis of the vein so as to transfix the skin and the upper wall of the vein and hold the vein solidly against the skin. The sharp cannula needle is inserted through the skin into the vein just below the cambric needle. The cannula is set proximally in the arm of the recipient and transfixed by a second cambric needle which passes in through the skin on one side, through the perforation in the shoulder of the cannula, and out through the skin on the opposite side. The same technic is used on the donor except that the cannula is placed distalward. A Luer syringe is washed in saline solution and rinsed in a 2 per cent. citrate solution, but no citrate solution is left in it except that which may adhere to its walls. The obturator is then removed from the cannula in the donor's arm and the curved adaptor with its small piece of rubber tubing and glass syringe is attached to the cannula. When the donor contracts his forearm muscles by opening and closing his hand, the blood is easily drawn up in the syringe. After 100 c.c. or more is drawn up, the syringe is detached and transferred to the recipient, while the assistant draws a second syringeful from the donor. After the syringe has been used, it is washed in saline solution and rinsed in citrate solution by the nurse. In this way three 100-c.c. Luer syringes are kept going in rotation, and from 600 to 800 c.c. of blood can easily be transfused in ten minutes. There is, however, no necessity for haste, according to Strauss, as the blood does not coagulate within the syringe for at least four or five minutes. In some cases an incision over the vein of the recipient may be necessary. In infants the blood is introduced into the longitudinal sinus through the anterior fontanel.

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[1] Head, Jerome R.: Surg., Gynec., and Obst., February, 1927.

[2] Brines, O. A.: Arch. Surg., 12, 124, January, 1926.

[3] Strauss, A. A.: Surg., Gynec., and Obst., 41, 678, 1925.

(*b*) *Citrate Method.*—In this method the blood of the donor is withdrawn through a short connection and immediately mixed with the desired quantity of sodium citrate solution. For every 10 c.c. of 2 per cent. sodium citrate solution 90 c.c. of blood are added, making a 0.2 per cent. solution or 2 grains to the liter. As the blood is mixed with the citrate solution clotting is prevented. The citrated blood may at leisure be reinjected into the vein of the recipient even after several days, if kept in an ice-box. A most useful apparatus for the administration of citrate transfusion is the apparatus of Dr. William H. Byford.[1] This apparatus consists essentially of a 1000-c.c. Erlenmeyer flask, in the bottom of which has been blown a glass connection of such size as to receive a rubber tube. The top of the flask is fitted with an air-tight cork which contains a glass tube. The latter is connected by rubber tubing to a pump or mouth suction. The needle which is connected to the base of the flask is inserted in the vein of the donor and as the blood flows into the proper amount of citrate solution its rate of flow is accelerated by the creation of negative pressure within the flask. The blood and citrate solution are gently agitated to secure proper mixing. After the required amount of blood has been withdrawn, the mixture of blood and citrate is injected into the vein of the recipient through the same glass connection at the base of the flask, using the same or a different needle. The rate of injection is accelerated by producing at this time a positive pressure within the flask. Care must be taken not to produce too high a positive pressure as the delicate Erlenmeyer flask may be caused to explode. The author has seen this happen.

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[1] Byford, William H.: Surg., Gynec., and Obst., Aug., p. 229, 1922.

Reactions after blood transfusion are often dependent upon factors other than the blood grouping. According to Rolleston,[1] there are three forms of reactions: (1) The acute, due to agglutination and hemolysis, which occurs immediately; (2) the delayed or proteolytic response coming on after from one to twelve hours; and (3) the systemic or constitutional reaction.

15. **Plaster-of-Paris Technic.**—The most suitable types of plaster-of-Paris bandage to use are those which are properly made in hospitals. The powdered plaster-of-Paris is thoroughly insinuated between the wide meshes of crinoline bandages by means of an appropriate machine. It is a matter of experience as to the quantity of plaster to use and the degree of tightness with which the bandages should be rolled. The commercial plaster-of-Paris bandages which are purchased in tin cans are never quite as suitable as those which are made in hospitals. The addition of a small quantity of sodium chloride to the water in which the plaster bandages are soaked will hasten the time required for their setting but it is generally unnecessary. The manner of immersion of plaster bandages varies according to the technic employed by various surgeons. Some men prefer to immerse the bandage wrapped up in a tissue paper cover, so as to prevent possible loss of plaster. The removal of the tissue paper, however, is time taking and impracticable. The best method is to place the uncovered bandage gently in a pail of tepid water and to allow it to soak until no more bubbles arise from it. The bandage is then carefully removed from the water and is grasped at either end. Compression is then made so as to squeeze the bandage together in an end-to-end manner to remove the excess water without losing more than is possible of the plaster-of-Paris (see Fig. 288).

For the application of plaster-of-Paris the skin of the affected site should be washed carefully with soap and water, alcohol, and dusted with talcum powder. An adequate length of stockinet should then be rolled upon the extremity in the manner described previously. The stockinet is then covered with cotton sheet wadding to the thickness desired. Where there are bony prominences these should be covered with appropriately shaped felt pads, the edges of which should be beveled. The wet plaster bandage is then carefully and smoothly wound around the portion of the body to be enclosed in the cast. A moderate uniform tension is kept upon the bandage and all wrinkles are to be avoided. As the layers of bandage are applied they should be constantly rubbed with the hand to insure the thorough filling of the meshes of the bandage with plaster-of-Paris. It is important that the extremity enclosed in the cast be properly supported during its application. The ill-advised grasping of a heel or knee through layers of wet bandages will cause, when the cast has set, a painful projection in the interior of the cast. A leg should be held by the toes and a hand by the fingers. If it is necessary to produce a small amount of flexion at the knee-joint, this should be done with great care not to make indentations in the cast. A broad surface should be employed to produce flexion. When the proper thickness of the cast has been obtained the ends of the stockinet may be turned back on the cast and made fast by a few additional turns of plaster-of-Paris bandage. It is best to have the patient remain quiet for fifteen to thirty minutes until the cast is thoroughly set before being moved. When the patient returns to his bed or home it will be well to leave the cast exposed to the air for about twenty-four hours to hasten drying.

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[1] Rolleston, Sir H.: Brit. Med. Jour., 1926, ii, 969.

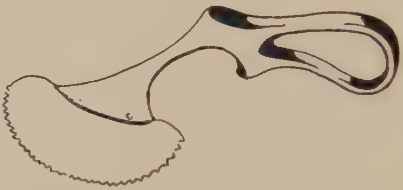

Fig. 431.—Saw for cutting plaster casts.

Various methods are employed in the removal of casts. The most useful is the large cast cutter. This is nothing more than a specially devised type of scissors with long handles to secure better leverage. In using it the blades of the cast cutter should be outside of the stockinet so as to minimize the danger of pinching the skin. In the absence of a cast cutter a sharp-pointed cast knife or cast saw (Fig. 431) will serve. The portion of the cast to be cut is moistened with water or hydrogen peroxide in order to soften it and a V-shaped trench is cut in it by means of the cast knife. Shelling and Cohen[1] advise the use of a 25 per cent. solution of potassium citrate for softening casts. This solution combines with the calcium. The solution may conveniently be applied by the trough-shaped instrument devised by Barnes.[2] This trench is gradually deepened until the cast is cut through, taking care to hold the cast knife at an oblique angle to the surface of the cast. This precaution is essential to minimize the danger of cutting the extremity beneath the cast. Certain very heavy casts will have to be cut on two sides so as to split it into halves for removal. The majority, however, may simply be spread apart by the hands or by the specially designed cast divulsor.

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[1] Shelling, D. H., and Cohen, M. D.: Jour. Amer. Med. Assoc., 91, 167, July 21, 1928.

[2] Barnes, L. P.: Jour. Amer. Med. Assoc., 91, 1288, October 27, 1928.

The technic of the making of molded plaster-of-Paris splints has been previously described. Herzmark[1] has described a useful devise for the making of plaster reinforcements. It can also be used for the making of molded plaster splints (Fig. 432). This device is made of two pieces of board 5 inches wide, 14 inches long, and ½ inch thick rounded down to about ¼ inch at the ends, and fastened together in the center by a block of wood 1½ inches thick, 2 inches wide, and 5 inches long. These two boards, held together by the central block, are mounted on a large clamp by means of a metal rod which is attached to a ratchet. The ratchet allows turning to the left but fixes the boards in a horizontal plane when pressure is made on the right. This was designed for the purpose of turning the boards a complete revolution to the left as the bandage is unwound from left to right and yet permitting the smoothing out of the layers in a horizontal plane.

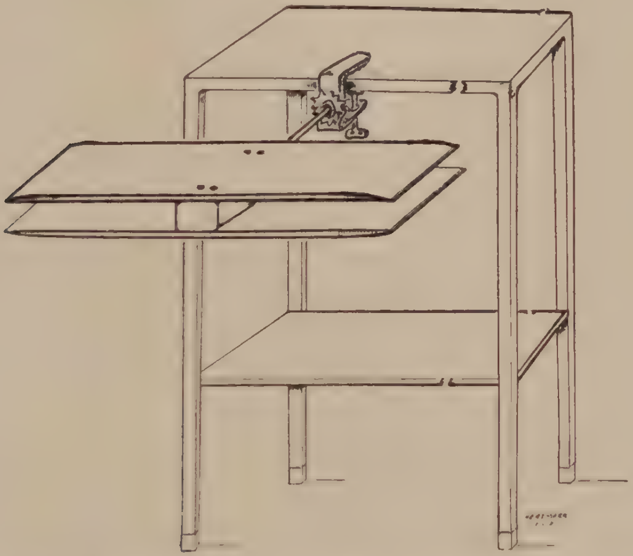

Fig. 432.—Device for preparation of plaster-of-Paris reinforcements. (Herzmark, M. H., Jour. Amer. Med. Assoc., December 8, 1928.)

The bandage is started at the left and rolled out on the upper board, which is held in a horizontal position. When the right edge is reached, the boards are turned to the left, a complete turn, thus permitting the bandage to be wound around the upper and lower boards. When the bandage has been unrolled in this manner the layers are smoothed out and the reinforcement is removed by cutting between the two boards at the ends. If a long reinforcement is needed, only one end is cut; by cutting at both ends two short reinforcement strips are obtained. The commoner circular casts for extremities also have been described.

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[1] Herzmark, M. H.: Jour. Amer. Med. Assoc., 91, 1802, December 8, 1928.

Witham[1] has described a method of making formed splints out of dental compound. They were used in cases of severe burns of the back of the hand.

A circular body cast for encasing fractures of the vertebræ without neurological symptoms is generally put on in the following manner: The patient is placed face downward upon the suspending hammock of an Abbott frame (Fig. 120a). Two layers of stockinet are placed about the patient's body and the canvas hammock is passed between them. The hammock is adjusted so that the proper degree of lordosis is obtained. After the stockinet and sheet wadding has been applied in the usual manner, felt pads are placed over the spines of the scapula, the spines of the vertebræ, the sacrum, and the crests of the ilia. The wet plaster bandage is then wound around the body, generally beginning over the hips and working upward. After the cast has thoroughly set, the end attachments of the hammock are unfastened and the patient is lifted to a cart. The hammock may then be withdrawn from beneath the cast. The cast should then be cut out so as to give ample room for defecation, to permit the thighs to be flexed, and to prevent cutting in under the arms.

Plaster hip spicas may be single or double according to whether one or both hips are to be enclosed. The patient is placed upon a Hawley table (Fig. 433), the shoulders rest upon the upper part of the table, the pelvis upon the pelvic support. An ample-sized felt pad is placed upon the vertical bar of the perineal support so as to protect the perineum when traction is applied. Traction is made upon the suspended extremity. With the patient held in the desired amount of abduction and inward rotation of the foot, the plaster cast is applied. Care must be taken to cut out the cast sufficiently from the region of the perineum to permit defecation and urination.

For tuberculosis of the spine body casts are constructed with the patient suspended by a neck halter. This rather difficult procedure is scarcely a minor surgical one.

16. **Bandaging.**—Bandages are employed to hold in place dressing

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[1] Witham, R. H.: Jour. Amer. Med. Assoc., 89, 6000, August 20, 1927.

and splints, and to support joints and certain fractures. The requisites for a successful bandage are,first, that it efficiently hold the dressing or splint in place; second, that it be comfortable; third, that *it does not come off*, and, fourth, that it have a neat appearance. Gauze bandages are most suitable for the majority of uses. Muslin bandages are used only where great strength is required but they cannot be so neatly applied. Many experienced bandagists believe that the best results are obtained with the muslin bandages, but that more skill is required to apply them. All bandages may better be accommodated to the convexities and concavities of the surfaces which they are to cover by the occasional turning or reversing of the bandage. Many types of bandages have elaborately been described in text-books on bandaging, but if the principles mentioned above are kept in mind practically any portion of the body may successfully be bandaged.

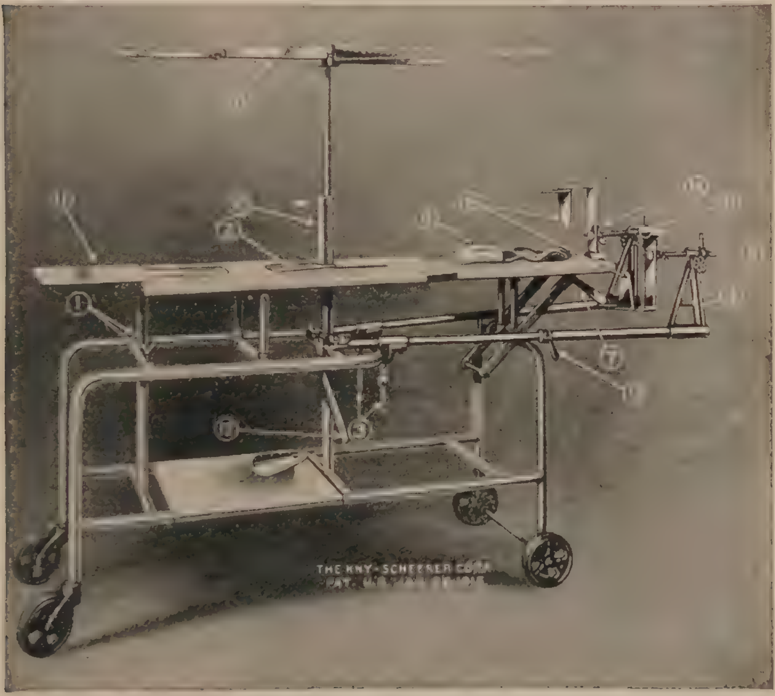

Fig. 433.—Hawley's fracture table.

A few special types of bandage deserve separate mention. The *head* bandage is applied by first making several turns around the head at the base of the skull, so that it is *firmly applied to both* the inion and the glabella (Fig. 434). A common error in head bandaging is to have

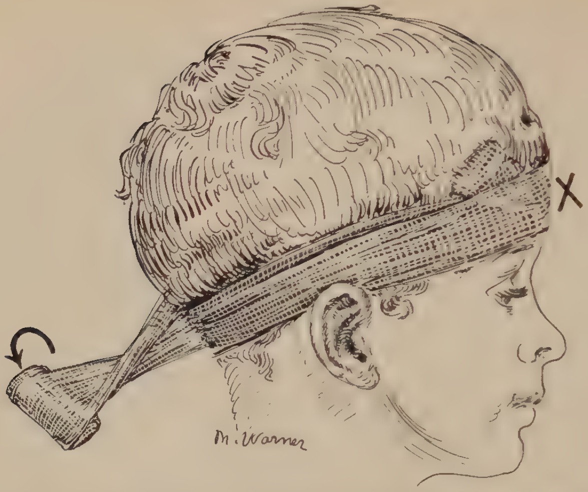

Fig. 434.—First step in a head bandage. The bandage is firmly wound over the occiput and forehead.

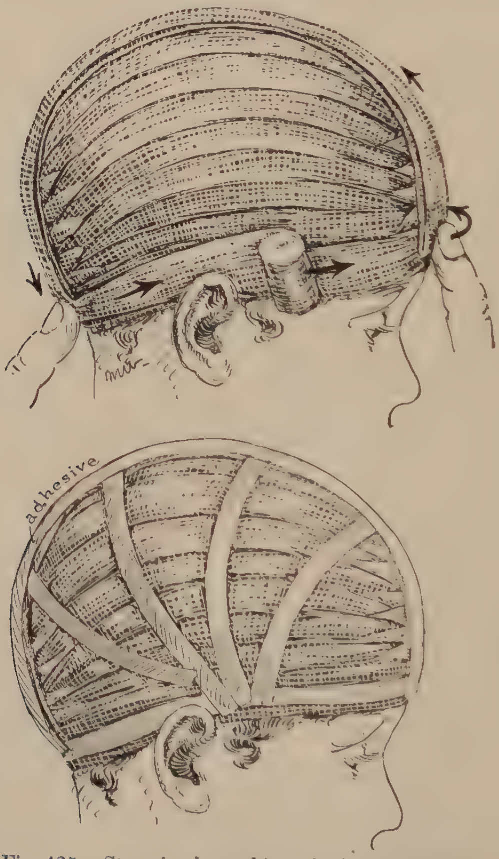

Fig. 435.—Steps in the making of a head bandage.

the bandage not extend low enough so as to include the external occipital protuberance. Back and forth layers of bandage are then applied and held at the ends by assistants until the entire cranium is covered, when the circular bandage just described is repeated. All head bandages are properly reinforced by transverse or circular strips of adhesive plaster (Figs. 435, 436).

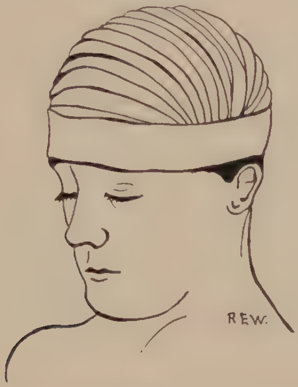

Fig. 436.—Transverse recurrent bandage of the scalp. (After Whiting.)

All *finger* bandages which are to be moistened should extend to and include the wrist in order to prevent their falling off. The attachment of the finger bandage proper to the wrist portion should be made by turns of bandage which pass over the dorsum of the hand and not over the palm. The end of the finger is covered by bandage by making several back and forth turns, which in turn are held by subsequent circular turns (Fig. 437).

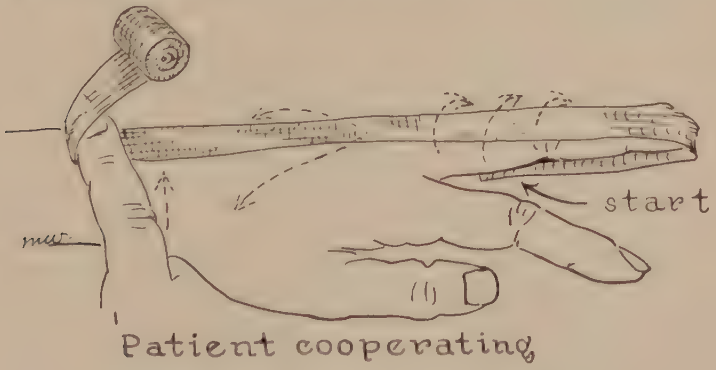

Fig. 437.—Finger bandage with extension to wrist.

The *Velpeau* bandage is applied as follows: "Standing facing the patient, the operator holds the bandage in the hand opposite the injured side, and with the other hand holds the free end against the chest of the well side. The bandage is carried across the injured side, crossing the middle of the arm, and is then carried across the back to the starting point. This first turn about the chest and arm anchors the bandage. The next turn passes obliquely across the chest to the injured shoulder, crossing the shoulder near its tip and passing down the back of the arm to the elbow, beneath the elbow, and up in front of the arm to the shoulder again, crossing the previous turn. From this point the bandage is carried obliquely across the back of the chest on the uninjured side at a point level with the injured elbow.

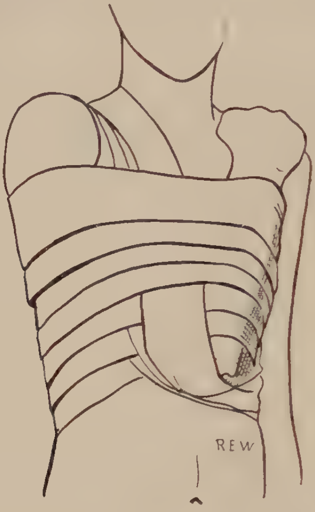

Fig. 438.—Velpeau bandage. (After Whiting.)

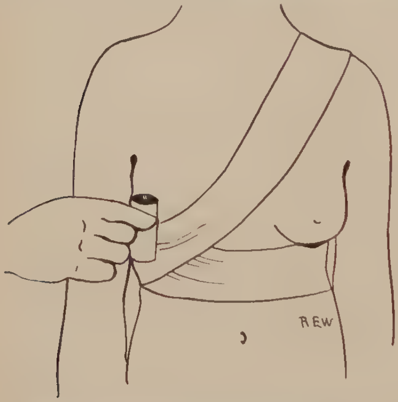

Fig. 439.—Suspensory of the breast. First turn. (After Whiting.)

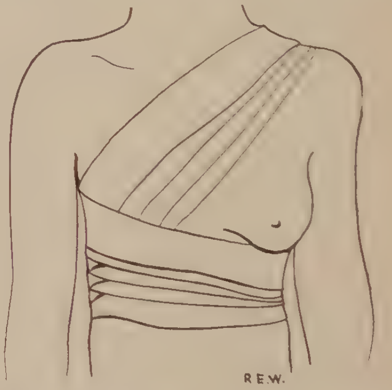

Fig. 440.—Suspensory of the breast. (After Whiting.)

From this point a circular turn is made about the body, including the injured elbow, bringing the bandage again to the chest on the uninjured side. From here the bandage is carried to the uninjured shoulder, down

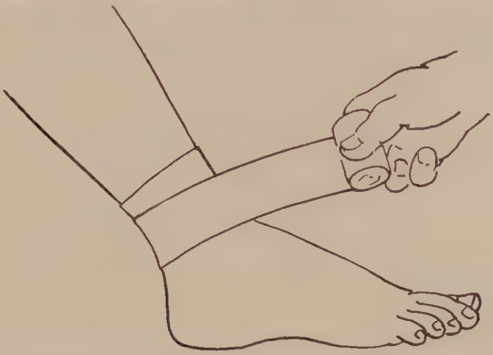

Fig. 441.—Circular method of fastening the initial extremity. (After Whiting.)

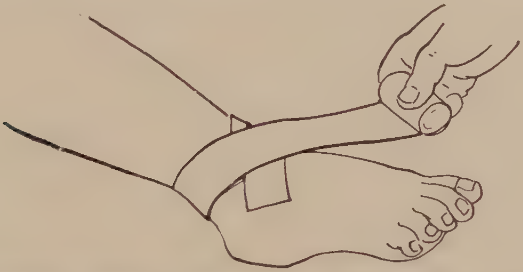

Fig. 442.—Oblique method of fastening the initial extremity. (After Whiting.)

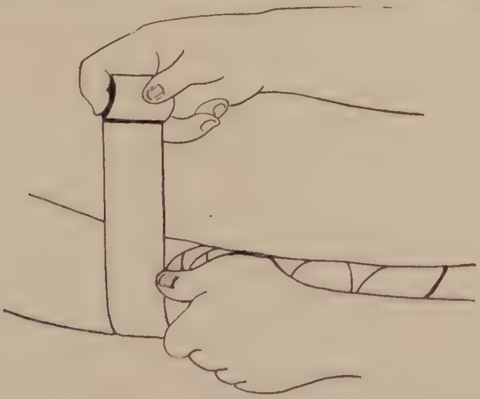

Fig. 443.—First step in making a reverse. (After Whiting.)

in back of the arm, up in front of the arm to the shoulder again, and then obliquely across the back to the starting point, following the previous similar turn and overlapping it about one half. The next turn is a cir-

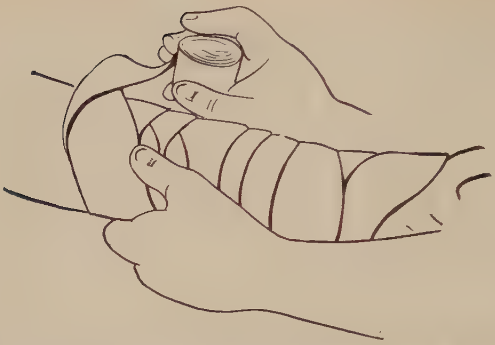

Fig. 444.—Second step in making a reverse. (After Whiting.)

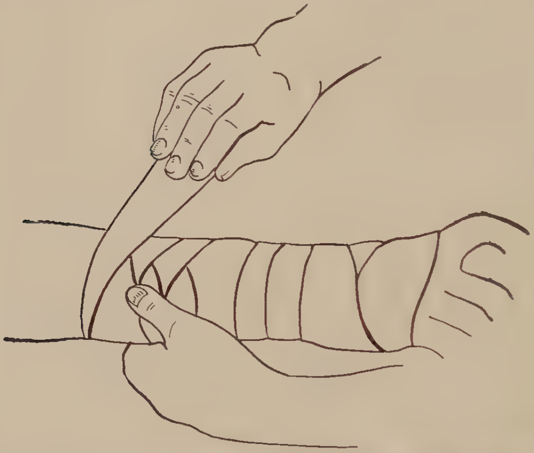

Fig. 445.—Third step in making a reverse. (After Whiting.)

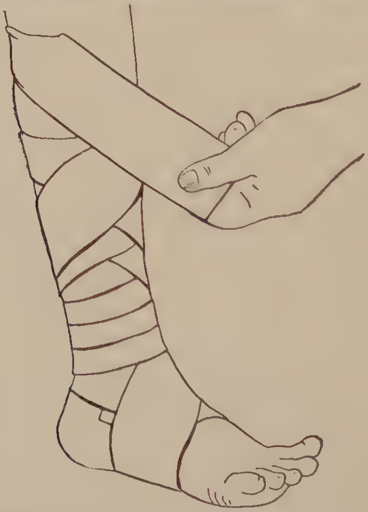

Fig. 446.—Modified spiral reverse of the leg. (After Whiting.)

cular turn slightly higher than the previous one, followed by a chest-shoulder-elbow-shoulder-chest turn" (Vaughan and Burnham[1]—Fig. 438). (See also Fig. 137.)

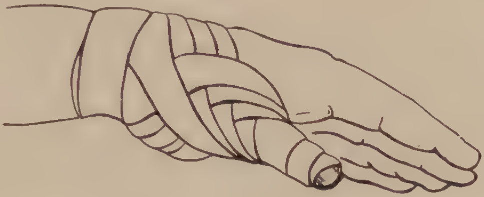

Fig. 447.—Spica of the thumb. (After Whiting.)

Figure-of-8 Bandage to Support the Breast.—This bandage is started at the shoulder, is passed down under the breast of the opposite side, under that axilla, over that shoulder, down in front of the chest under the opposite breast, under that axilla, over that shoulder, and so on (Figs. 439, 440).

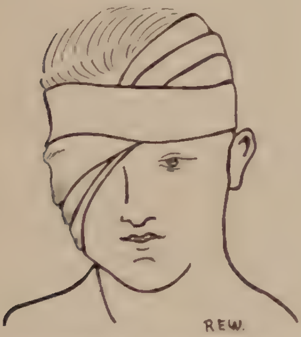

Fig. 448.—Monacle bandage of one eye. (After Whiting.)

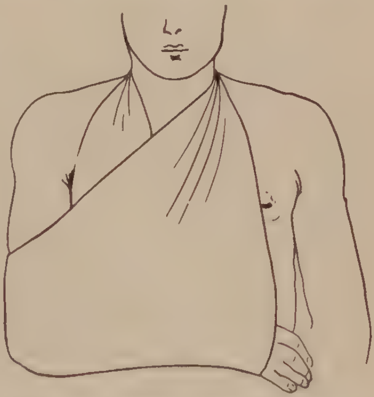

Fig. 449.—Sling. (After Whiting.)

Figure-of-8 Bandage to Support the Clavicle.—In this bandage proper sized felt pads are placed on the front sides of both axillæ. The bandages are crossed on the back so as to form a figure 8, the loops of which include the shoulders and hold them back.

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[1] Vaughan, J. C., and Burnham, A. C.: Minor Surgery, Lea & Febiger, 1922, p. 528.

CHAPTER XXIV

THE SURGICAL INTERN

A SURGICAL internship presents a twofold opportunity. The surgical intern has an opportunity to observe and to participate in surgery. He has an opportunity to learn at close hand the surgical methods and the technic of dealing with patients of surgeons who are most respected in the community, and he has the opportunity to gain the approbation of such surgeons with whom he might desire to become associated. The intern who most successfully cares for the patients assigned to his care and who best serves the interests of his attending men generally will be the most successful in his practice.

In speaking of internships Irons[1] says, "What should this internship give him (the intern)? First and foremost it should develop further his character, through close daily contact with attending men of high ideals. He should see by daily observation how honesty, sincerity, sympathy, are combined with knowledge and experience in dealing with the medical and surgical problems of each patient. . . . He learns how to get on with crabbed sick folk who might or might not be crabbed if they were well. He puts in practice what he has learned of the uses as well as the limitations of instruments of precision and of clinical and biological tests, and gets a sense of relative values when he combines them with history and physical examination in the making of a diagnosis."

I. GENERAL QUALIFICATIONS OF THE SURGICAL INTERN

1. **Industry.**—An intern must expect to work hard. There is always more work that should be done and can be done than there is time in which to do it. He must not only work hard but he must work efficiently. He will so have to plan his work as to minimize the number of unnecessary trips about the hospital. He should be prompt in his taking care of all calls for accident cases or emergencies which may arise within the hospital, no matter how trivial they may seem to him when reported. He must never forget that patients often suffer extreme though unnecessary apprehension because of conditions which

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[1] Irons, E. E.: Jour. Amer. Med. Assoc., 86, 966, April 3, 1926.

he knows are relatively innocuous, and it is part of his duty to allay the mental as well as physical suffering. Moreover, occasionally, occurrences may be reported to him by the nurse which he may find are of grave seriousness on his arrival. No chances should be taken.

The work is very hard and the intern should endeavor to get a certain amount of rest in his time off. But as Carrington[1] says, "If you think you are overworked, you are a round peg in a square hole, because in private practice you will work harder than ever an intern worked."

2. **Intelligence.**—The good surgical intern will be intelligent. He will grasp quickly what is told him and he will be alert to understand all the procedures which are taken. Those which he does not understand he will inquire or read about.

3. **Tact** is essential to the intern. He will often be severely cross-questioned by the patient in the absence of the attending doctor, particularly as to the possible prognosis of the ailment. The writer has seen the parents of a child with a mild concussion of the brain thrown into the wildest panic by the grudging admission of the intern in answer to their insistent questions, that occasionally a craniotomy may be required in such cases. A terror-stricken woman with a radical amputation of the breast was pleasantly informed by a conversationally inclined intern that he knew how she felt "because his mother died with cancer." The writer has seen the professional instinct so transcend the social as to cause one of a group of physicians in consultation at a patient's bedside to inquire in an all too audible voice, "all these patients die do they not, doctor?"

4. **Judgment.**—Good judgment in some cases is inherent with men; in others it may be acquired by experience; in others it is never acquired. In the absence of the attending surgeon an intern is often required to make an instant decision. Severe hemorrhage, a burn case, or severe shock may call upon him for exercise of good judgment. The best way for an intern to acquire this judgment is to anticipate continuously all types of situations which may require his attention.

5. **Personality.**—The average intern is perhaps a little overconscious of the recentness with which he has graduated and is hypersusceptible to what he thinks may be the inward contemptuous criticism of him by the patient. He may accordingly adopt a rather blustery "know-it-all" manner to cloak his real or supposed deficiencies. It is far better to gain a patient's admiration and confidence by courtesy, modesty, and by zealous efforts in behalf of the patient's comfort and health.

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[1] Carrington, W. J.: Jour. Med. Soc. of New Jersey, 23, 398, August, 1926.

He must endeavor to have at all times a neat appearance. After an intern has been up all night a shave and a fresh suit of clothes will help him rather than be an extra burden.

6. **Loyalty.**—The intern should be loyal to his attending man. He is the personal representative of the attending man in the latter's absence and should strive to take care of the patient as conscientiously and as thoughtfully as would the attending man were he present. He may have profound differences of opinion with the attending man as to the proper conduct of the case. Not infrequently such differences of opinion are just and well grounded. Such differences of opinion can respectfully be taken up with the attending man, often to mutual profit, but they should *never* be confided to the patient or to the nurse in attendance.

A surgeon working at high tension in the operating room may be unjustly impatient with an intern. The intern should strive to be patient and self-contained under such circumstances and should try to remedy the situation by greater efforts. He must remember that very soon he will be similarly situated.

The intern should be loyal to the hospital. If he will take pains to familiarize himself with the difficulty and the multiplicity of detail in the administration of a hospital,[1] he will become far more sympathetic with its problems. Should a patient unjustly criticize the hospital, the intern will not only help the hospital but also the patient's welfare by endeavoring to explain to the patient the real state of affairs, of which the patient may have no knowledge.

The intern will find it greatly to his profit and to the pleasure of his sojourn in the hospital to be uniformly courteous and respectful to nurses. Under no circumstances should he be familiar with nurses. It is generally desirable to address as many nurses as possible by their names. Suggestions as to treatment when made in the proper spirit by older, experienced nurses may well be given careful attention. Where the intern feels, however, that he is on sure ground he should maintain his authority and not modify his orders to suit the nurse An intern should never criticize a nurse in the presence of or within hearing of a patient.

7. **Responsibility.**—The intern may never take his relation to his patients lightly. On him lies a heavy responsibility, and the more seriously and conscientiously he accepts that responsibility, the greater will be the responsibility and trust given him.

8. **Integrity.**—This of course is a sine qua non. The word of an

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[1] Heaton, H.: Modern Hospital, 26, 307, April, 1926.

intern must absolutely be depended upon. Momentous decisions may depend upon it. The examination of a urine by the "sink" test is grounds for dismissal.

II. DUTIES OF INTERNS TO PATIENTS

Patients should be seen by the intern as soon as possible after their admission to the hospital. They are generally apprehensive, and a friendly word of assurance, telling them that the necessary examinations will be started without delay, will often put them at their ease. Emergency cases of all kinds will require prompt, gentle, and intelligent service.

1. **History.**—The intern's introduction to the patient generally will come with the taking of the history. Patients having a rather obscure complaint will generally welcome this procedure. Others, whose ailment is apparent, may be somewhat vexed to again have to answer questions which they already have answered fully to the attending surgeon. Not only may the intern, by his history, make a valuable record of the case but also he may uncover valuable facts which have escaped the attending surgeon. To those patients who seem to offer objections to the taking of the history a good-natured explanation will generally insure co-operation. The detail with which the history is made will vary with the type of the case and with the wishes of the attending surgeon. In obvious surgical afflictions, such as fracture, lacerated wounds, and the like, a very brief history will suffice. In cases of exophthalmic goiter, possible cholecystitis, gastric ulcer, and the like, however, extremely careful and complete histories will be necessary. These will be carried out in a methodical manner. The following outline, which has been adopted by the Medical Division of Northwestern University Medical School as a teaching guide to students, is very useful:

"The medical history should be an intelligent, logical, and chronological story of the patient's present complaint and other clinical data which might have a bearing on the patient's condition.

"Medical cases vary greatly in their complexity. Some cases are so obscure that every possible piece of evidence derived from the history should be brought to the front. The simple way of avoiding omissions is to adopt, and by practice become proficient in, a regular method of procedure which, if followed, will cover all symptoms presented by the patient. A skeleton outline which suggests the general type of information desired but which is not intended to be complete, or preclude special investigation in individual cases, is here offered:

"1. *Statistical Data.*

Name
Color
Address
Sex
Age
S. M. W. D.
Occupation

"2. *Immediate Complaint.*—Under this head should be arranged the presenting symptoms as offered by the patient in the order named. Number the symptoms 1, 2, 3, 4, etc.

"3. *The Present Illness.*—Here is recorded in medical phraseology the progress of the disease from its onset to the present time. As nearly as possible the date, the character, and the course of the onset as given by the patient should be recorded. Following this the progress of events should be arranged chronologically as the symptoms have occurred up to the present time. Finally, the course of the disease should be noted.

"Up to this point the information should be obtained from the patient by indirect questions; the patient should be allowed to tell his story in his own way without being influenced by direct questions, as, 'Have you a pain in your right side?' etc.

"Notes previously taken are now used in writing the history of the present complaint on a permanent history sheet.

"4. *Inventory by Symptoms.*—Direct questions may now be used in order that a complete inventory of the patient's condition may be taken under the heading given below. In this manner symptoms which may be forgotten or regarded as unimportant may be elicited and recorded.

"*General.*—Personality, nutrition, deformities, weakness, edema, dyspnea, fever, night sweats, jaundice, tremor, falling hair, skin eruptions. Weight: Loss or gain; over what period?

"*Head.*—Headache: Time of onset, duration, intensity, frequency, location. How modified by rest, sleep, or excitement, or drugs? Injuries.

"*Eyes.*—Failing vision. Glasses. Diplopia. Pain. Photophobia. Scotomata.

"*Ears.*—Deafness: Unilateral or bilateral. Pain. Discharge. Tinnitus. Vertigo.

"*Nose.*—Obstruction. Nose colds. Discharge. Epistaxis.

"*Mouth.*—Glossitis. Gingivitis. Condition of the teeth.

"*Throat.*—Sore throat. Tonsillectomy. Hoarseness.

"*Cardiovascular.*—Chest pain: Location, character, referred, severity, how produced. Asthma. Palpitation. Tachycardia. Faintness. Vertigo. Dyspnea: Severity and character. Edema: Type.

"*Respiratory.*—Chest pain: Location, character, relation to respiration. Cough: Duration. Sputum: Character, amount, blood. Dyspnea: Type.

"*Gastro-intestinal.*—Appetite: Normal, increased, decreased. If patient does not eat, is it because of distress? Abdominal distress or pain: Location, time of occurrence, periodicity, relation to food, effect of alkalies, relation to bowel movement. Differentiate between distress and pain. If patient has had attacks of distress or pain, describe a 'typical attack.' Nausea. Vomiting: Character of vomitus, hematemesis. Belching. Flatulence. Constipation: Cathartics, enemas. Diarrhea: Number of stools daily. Stool: Time, consistency, color, mucus, blood, undigested food. Hemorrhoids.

"*Genito-urinary.*—Genital: Discharge. Sores: Location and character. Bubo. Urinary: Urine: Frequency, increase or decrease in amount; nocturia; incontinence. Character of urine; pyuria; hematuria. Pain: Location, time of occurrences, relation to urination.

"*Neuromuscular.*—Temperament. Emotional state; worry, fear. Motor disturbances: Muscular weakness, ataxia, convulsions, tremors, paralysis. Sensory disturbances: Fainting, paresthesia, anesthesia.

"5. *Past History.*—Record in chronological order all past illnesses, injuries, and operations. Record the date, duration, severity, complications, type of convalescence, and sequelæ of each.

"Inquire specifically in regard to vaccination, scarlet fever, chorea, acute rheumatic fever, sore throat, tonsillectomy, association with cases of tuberculosis, pleurisy, dental care, venereal diseases.

"6. *Habits.—Social and Working Conditions.*—Inquire regarding: Occupation; hygienic conditions, mental and physical strain. Sleep, exercise. Recreation. Drugs, alcohol, tobacco, coffee, tea.

"7. *Sexual History.*—Male: Marital: Duration. Health of wife. Children. Miscarriages. *Female:* Menstrual cycle: Age of beginning, regularity, duration, amount, pain. Menopause. Leukorrhea. Obstetrical: Number of pregnancies; labors—normal, abnormal, instrumental. Puerperium. Miscarriages, abortions. Complications of pregnancy, convulsions, edema.

"8. *Family History.*—State the significant illnesses which have occurred in the immediate family—father, mother, brothers, sisters, husband or wife, children. If living, state of health. If dead, age and cause of death. Inquiry should be made in particular regarding cancer, tuberculosis, diabetes, arthritis, insanity, and goiter. The history is concluded with a summary."

2. **Physical Examination.**—Great tact may be necessary in performing a physical examination upon a patient who has already been examined by the attending surgeon. In some patients the examination may be omitted at the expressed wish of the surgeon, but this is unusual. Female patients should under no circumstances be examined in the absence of a nurse. Rectal examinations should always be made instead of vaginal examinations in virgins. Cases in which there is hemorrhage from the vagina should have no vaginal examination at all.

The chief purpose of a routine physical examination is the accurate recording of the patient's physical condition and the possible revelation of pathology hitherto unsuspected. The physical examination will be systematic. The following is the outline guide for physical examination adopted by the Medical Division of the Northwestern University Medical School.

"1. *General Appearance.*—Race. Sex. Apparent age. Behavior. Posture. Gait. Nutrition. Height. Weight. Pulse. Temperature. Respiration. Blood-pressure. Flushing. Pallor. Cyanosis. Icterus. Eruption. Pigmentation. Edema: Location, time of appearance.

"*Systemic Examination:*

"*Cranium and Scalp.*—Scars, hair, exostoses, cranium deformities.

"*Face.*—General appearance.

"*Eyes.*—Prominence of globe; exophthalmos; movements; coordination; conjunctiva; lids; ptosis, edema. Pupils: Size, shape, equality, reaction to light and accommodation; visual fields. Ophthalmoscopic examination.

"*Ears.*—Watch heard at ? cm. Condition of auricle; meatus and aural canal; discharge; tophi.

"*Nose.*—Deformities; obstruction; discharge.

"*Lips.*—Color; herpes; ulcerations; fissures.

"*Mouth.*—Breath; ulcerations; pigmentations. Teeth: Missing; cavities; apical infection; discoloration; dentistry. Gums: Character; bleeding; pyorrhea; lead line. Tongue: Coat; eruptions; direction of protusion; tremor. Tonsils: Size, color, infection, exudate; anterior pillars. Pharynx: Color; catarrh; palate; reflexes; adenoids. Larynx: Character of voice.

"*Neck.*—Mobility; thyroid—character, bruit, lymph-glands; tracheal tug.

"*Thorax.*—Inspection: Symmetry, size, and shape; expansion on both sides; depth and character of respiration; suprasternal notch; xiphocostal angle; supra- and infra-clavicular fossæ; Litten's phenomenon; Broadbent's sign; abnormal pulsations.

"*Lungs.*—Palpation: Vocal fremitus (compare two sides); pleural friction; succussion.

"Percussion: Resonance; dulness; flatness; outline Krönig's isthmus; border; apex; excursion of diaphragm (mark with skin pencil).

"Auscultation: Prolonged breath and voice sounds; râles; friction sound.

"*Breasts.*—Size; tumors; scars. Nipples: Retracted; discharge.

"*Heart.*—Inspection: Apex beat (mark); precordial pulsations.

"Palpation: Left cardiac border; apex beat; abnormal pulsations; thrills.

"Percussion: Outline and mark with skin pencil cardiac borders; measure (midsternal line to left and right borders); cardiac displacement.

"Auscultation: Tones—first and second; at apex, pulmonic area, aortic area, tricuspid area; note quality; reduplication. Murmurs: Location, time, transmission; effect of respiratory excursion, lying and sitting; pericardial friction.

Aorta: Palpitation; percussion; auscultation; width.

"*Peripheral Vessels.*—Arteries; radical pulse rate; rhythm; equality; character of vessel walls; brachial, temporal, femoral; capillary pulse. Auscultate femoral arteries; Traube's tones; Duroziez's murmur. Veins: Note any abnormalities.

"*Abdomen.*—Inspection; type—obese, scaphoid, ascitic, gas, enteroptosis; peristaltic waves.

"Enlargements: Veins, hernia.

"Palpation: Rigidity; tenderness, local or diffuse; tumors; friction.

"Liver: Size, dulness, excursion, notch, regularity of lobes, resistance, tenderness; tumors; scars; pulsations; friction; murmurs.

"Gall-bladder: Palpability; tenderness.

"Spleen: Splenic dulness; excursion; notch; resistance; tenderness; regularity; friction.

"Kidney: Movability; size, regularity, tenderness.

"Stomach: Size, peristalsis, palpation, local tenderness, tumors.

"Colon: Palpability; spasticity; tumors.

"Bladder: Palpability.

"*Rectal.*—Hemorrhoidal veins; fistulæ; fissures; sphincters; stricture; tumor; discharge.

"Prostate: Tumors, tenderness. Seminal vesicles.

"*Genitalia.*—Male: Malformations; discharge; ulcers; scars. Testicles: Atrophy, inflammation, tumor, epididymitis. Hydrocele. Varicocele.

"Female: Ulcers; inflammation; discharge. Perineum. Vaginal: Hymen, cervix, fundus, adnexa, tumors, tenderness, fixation.

"*Inguinal Rings:*

"*Lymphatic Glands.*—Cervical, axillary, inguinal, epitrochlear.

"*Bones.*—Spine: Scoliosis, lordosis, rigidity, tenderness; other bones; exostoses; irregularities; tenderness.

"*Extremities.*—Arms: Wasting, joint changes; club fingers; nails; tremor, involuntary movements: athetosis, choreiform.

"*Reflexes.*—Elbow; knee; ankle; Babinski; plantar."

During the conduct of the examination the intern should observe particular tact. He will continually be plied with questions by the patient as to the nature of the ailment and the significance of the findings. To these questions a noncommittal reply should be made.

3. **Orders for the Patients.**—Interns will be responsible for orders for the medications and treatments given patients. On the admission of the patient orders for diet, blood-counts, and urine should be left immediately. The routine preoperative orders will be given in accordance with the custom of the individual attending surgeon. These should be given as soon as possible to facilitate the work of the nurses and orderlies. In the absence of a knowledge of his customary orders the intern should ask him what he desires. The same applies to postoperative orders. Where there is any question as to the indication for an order the intern should consult the attending man. The orders should be written in ink and signed. A routine test of the coagulation time of the blood is of value, particularly on tonsil cases and in the presence of jaundice or where there is a history of hemophilia. In all patients who are in poor condition or where the operation is liable to entail an extensive blood loss it will be advisable to have the blood typed before operation. A suitable donor will be found and his blood will be matched with that of the patient before the operation. A functional kidney test is of importance in patients with renal or prostatic involvement. In discussing preoperative care Moynihan[1] says that "One of the most valuable procedures for lessening the risk of operation is blood transfusion. This may be used both before and after operation. The transfusion of 15 ounces of blood a few days after a gastrectomy for carcinoma or jejunal ulcer may greatly improve the prognosis."

Before the operation the patient should be encouraged to drink as much fluid as possible for a day or two. A 5 per cent. glucose solution is best. As a rule a single evacuation of the intestine the evening before the operation is sufficient. Flatulence is more common in patients who have been purged than in those who have not been purged. Thalheimer, of Milwaukee, has suggested the giving of glucose and insulin in surgical shock and other conditions. He has also used it in preoperative preparation. Anderson's[1] usual procedure is as follows: The patient is given 60 gm. of glucose in a glass of lemonade and 20 units of insulin by hypodermic injection the day before the operation. The insulin is given the day before the operation in order that the reaction will not come on unrecognized and in order that the antagonistic action of atropine which is administered preoperatively may be avoided. Anderson believes that patients prepared in this manner withstand long and difficult surgical procedures with very little postoperative reaction. The patient's normal routine of life should be disturbed as little as possible before the operation.

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[1] Moynihan, Lord: Lancet, 1926, 211, 789.

In cases of jaundice, where the bleeding time may almost contraindicate operation, the coagulation time may be shortened, according to Moynihan,[2] by the administration of freshly prepared rabbit serum in doses of 20 c.c. repeated twice or three times. Five c.c. of a 10 per cent. calcium solution given intravenously on three or four consecutive days before and after the operation has a similar effect. This is in line with the recent work of Waltman Walters.

Satisfactory routine orders for the ordinary case of appendicitis or inguinal hernia would be as follows:

1. Prepare the field of operation (this consists of shaving the skin after a soap and water lather; a dry shave is occasionally indicated in emergency cases where an iodine preparation is to follow immediately after the shave). In certain bone cases and others where a sterile preparation is desired the field is washed with alcohol after the shave and is covered with sterile gauze. The orderly should be instructed to shave for at least 6 inches beyond the anticipated operative field.
2. *No* preoperative laxative.
3. Soapsuds enema on the morning of the operation.
4. Morphine sulphate, grain $\frac{1}{6}$ to $\frac{1}{4}$, and atropine sulphate, grain 1/150, by hypodermic one-half hour to forty-five minutes before operation.

In some types of cases, depending upon the wishes of the attending surgeon, scopolamine and morphine are given. These drugs are generally given in cases to be operated upon under local anesthesia. Some authorities give morphine sulphate, grain $\frac{1}{6}$, and scopolamine, grain 1/150 to 1/120, forty-five minutes before operation. Others give morphine sulphate, grain $\frac{1}{6}$, and scopolamine, grain 1/200 or 1/300, two hours and one hour before the operation provided there is not undue slowing of the respiration or interference with the pulse at the time of the administration of the second dose. The head is completely shaved in head cases; the stomach is washed out in gastric cases or in intestinal obstruction.

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[1] Anderson, C. M.: California and Western Medicine, 1927, 27, 56.

[2] Moynihan, Lord: Lancet, 1926, 211, 789.

In their splendid paper on the Preoperative Preparation and Postoperative Care of Surgical Patients, Kanavel and Koch[1] include the following:

In preparing hand cases the hand should be soaked in warm soapy water for twenty minutes on the day preceding operation, and for twenty minutes on the morning of operation, and the nails should be carefully cleaned and trimmed. The hand and forearm should be shaved, and every effort made to have the hand as clean and free from thick calloused skin as possible.

Before radium application to the cervix the perineum should be prepared as for perineal operations.

Before cystostomy or prostatectomy the bladder should be irrigated and distended with sterile water; the catheter, which is clamped off, should be left in place.

Before operation for spina bifida, cleft-palate, etc., infants should be bandaged in cotton wool as completely as possible before coming to the operating room.

Before cystoscopic examination the patient should drink six glasses of water in the hour or two preceding examination. No morphine is given except to very nervous patients.

Patients who require scrubbing immediately before operation, such as hemorrhoid cases, vaginal cases, etc., and patients who require catheterization before operation, such as cases of pelvic laparotomy, should reach the operating room ten minutes before the time set for operation so that administration of the anesthetic will not be delayed by the necessary preparation of the field of operation.

The following paragraphs as to care of patients are quoted from Kanavel and Koch[2]:

"*General Principles of Postoperative Care.*—Three things are essential for prompt recovery after operation: Rest, fluids, food. None of them can be dispensed with for twenty-four hours without definitely prolonging the postoperative course.

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[1] Kanavel, A. B., and Koch, S. L.: Bulletin of the American College of Surgeons, 11, 14, July, 1927.

[2] Ibid.

"The fluid intake and output and the caloric intake should be carefully recorded during the critical days of the postoperative course. Unless this is done in every case, renal insufficiency with resulting toxemia or acidosis is certain to develop. For a patient of 150 pounds weight, 4000 to 5000 c.c. of fluid should be given every twenty-four hours for the first few days after operation. Three thousand calories for a twenty-four-hour period constitute the minimum food intake on which a patient of average weight can be expected to gain in weight and build body tissues.

"*Rest.*—To insure rest, morphine in $\frac{1}{4}$- or $\frac{1}{6}$-grain doses, depending on the age and weight of the patient, is the most effective means at our command. Codeine in $\frac{1}{2}$-grain doses, or heroin in 1/12-grain doses (for an adult of 150 pounds), sometimes forms an effective substitute. If the patient has an idiosyncrasy for opiates, hyoscine hydrobromide, grain 1/120, will usually be effective. Such drugs should be given hypodermically for twenty-four or forty-eight hours at such intervals as are necessary to maintain the patient's comfort, though it is rarely necessary to give more than 2 doses in the first twenty-four hours and 1 in the second twenty-four hours. Sedatives should preferably be given late in the day so as to insure rest during the night. A patient should not be allowed to reach the limit of his endurance during the first or second night after operation and finally receive a sedative at 1 or 2 o'clock in the morning. Forethought and anticipation will help a great deal to make the postoperative course less trying both for the patient and the nurse.

"After twenty-four or forty-eight hours, 15 or 20 grains of triple bromides for the adult patient of average weight, given for a few evenings at 7 o'clock, will help to keep the patient comfortable through the night. Veronal, sulphonal, or trional in 10- or 15-grain doses, choral 10 grains, luminal $1\frac{1}{2}$ grains, or allonal 4 grains may sometimes be substituted to advantage.

"*Fluids.*—No one therapeutic measure is of greater importance and none so frequently neglected or inadequately carried out as the administration after operation of an adequate amount of fluid, *i. e.*, 4 or 5 liters each twenty-four hours for an individual of average weight. Dehydration, acidosis, a rapid pulse, and persistent nausea from ether retention are only a few of the common sequelæ of a general anesthetic that has not been followed by administration of sufficient fluid to compensate for the loss of body fluids from perspiration and vomiting, and to promote the highest possible degree of elimination.

"After a general anesthetic fluid can best be given for twenty-four or forty-eight hours by rectum, either continuously or as a high enema, 1 pint every three hours (Fig. 450). The former method is usually more satisfactory, though ordinarily 2 to 4 pints may be given without difficulty as a retention enema immediately after the patient returns from the operating room. Tap water is less irritating than salt solution for the average patient. Five per cent. glucose solution with 3 per cent. sodium bicarbonate is often well tolerated and adds a definite food value to the fluid. If a Y-tube is inserted below the dropping apparatus and from it a second tube is led back to the enema can, gas may escape through the second tube and prevent the backing up of fluid in the apparatus. If the patient begins to expel the fluid the catheter should be removed for a few hours. Ordinarily after a few hours' rest proctoclysis can be resumed without difficulty.

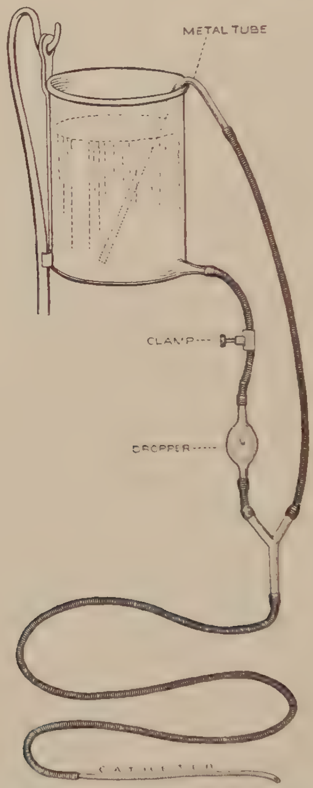

Fig. 450.—Apparatus for proctoclysis. (Kanavel, A. B., and Koch, S. L., Bulletin of the American College of Surgeons, 11, 3, July, 1927.)

"If for any reason fluid cannot be given by rectum it should be given subcutaneously until such time as the patient can take it freely by mouth. The needles used for hypodermoclysis should be sharp, bright, not longer than 3 inches, and not larger than 20 English standard wire gauge. If a small wheal of skin is raised with 2 per cent. novocaine, injected through a hypodermic needle at the anterior axillary line at the level of the nipple, the needle may be inserted with little discomfort to the patient. They should be inserted in the loose subcutaneous tissue of the axilla, not into or underneath the breast, and directed toward the center of the axilla. After they are inserted a gauze sponge should be wrapped about the hub of the needle and a strip of adhesive laid over it to hold it securely in position. The addition of a small amount of novocaine[1] to the salt solution makes its administration practically painless.

"Hypodermoclysis may be continued for a number of days without any serious discomfort to the patient and often without removing the needles. When the first flask is emptied the tube is clamped off as close to the flask as possible, the cork with the two tubes is removed without disconnecting the rubber tubing, and inserted into a second flask. If a little air gets into the system it will do no harm. If the needles become plugged with coagulated serum, gentle milking of the rubber tubes leading to the needles will often force the obstruction from the needle. If it does not, the needles should be removed, cleaned, resterilized, and reinserted.

"When fluids are given by rectum or subcutaneously the temperature of the fluid should be tested by allowing it to run for a moment on the back of the hand. The temperature should not be above 108° nor below 96° F. By placing a bottle of very hot water inside the proctocylsis can, or by wrapping a hot-water bottle about the flask of salt solution and a second hot-water bottle about the tubing under the bed-covers, the temperature of the fluid can usually be kept within the optimum limits.

"In an urgent case, with a patient depleted by vomiting or hemorrhage, salt solution or glucose solution, 10 to 20 per cent., may be given intravenously.[2] It must be warm and given slowly to avoid placing too great a strain on an enfeebled heart. Glucose may be given at the rate of 1 gram per kilo of body weight, *i. e.*, 600 c.c. of 10 per cent. solution for an individual of 132 pounds. Insulin may also be given, 1 unit for 4 to 5 grams of glucose, to assist in its oxidation. If a suitable donor can be secured, transfusion of blood should be carried out without delay.

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[1] Addition of 8 c.c. or 2 drams of a 2 per cent solution of novocaine to a liter of salt solution forms practically a 1 : 7000 solution.

[2] Sterile glucose may be procured in ampules ready for use. If the solution is prepared in the hospital, glucose which is absolutely free from impurities must be used, or untoward reactions will result.

"As soon as nausea has disappeared fluids may be given in small quantities by mouth and warm rather than cold. As soon as the patient can take fluids freely by mouth other means of giving it are discontinued.

"*Food.*—For twenty-four or forty-eight hours liquid diet alone is least likely to upset the patient. After that time soft diet—custards, ice cream, soft-boiled eggs, toast, etc.—may be added according to the patient's appetite and his ability to tolerate food.

"With patients who have been ill for some weeks or months, perhaps with an unrecognized empyema or an accumulation of pus within the abdomen or pelvis, the question of nutrition becomes of primary importance. Liquid foods of high caloric value—egg-nog, chocolate, malted milk, lemonade with lactose to the point of saturation, and thick broths—are particularly valuable immediately after operation, and may be supplemented by the addition of eggs, custards, fruit, and solid food as soon as the patient can tolerate them."

4. **Postoperative Complications.**—(*a*) *Thirst.*—In cases where ether has been given it is generally wiser not to give fluids by mouth until the nausea has ceased. This may be a few hours or twelve or longer. Efforts to allay the thirst must be by proctoclysis or hypodermoclysis. Washing the patient's mouth with liquor antisepticus or ice-water is very comforting. After ethylene anesthesia many surgeons permit the ingestion of water at once. Certainly it need not be long deferred.

(*b*) *Vomiting.*—The ordinary postoperative vomiting usually subsides after a few hours. In the protracted cases the "automatic lavage" is tried. In this procedure 2 or 3 tumblerfuls of warm water, each containing 1 dram of soda bicarbonate, are given by mouth and the patient is encouraged to regurgitate it. The loss of chlorides, as well as water, occurs in vomiting. Postoperative nausea and vomiting are greatly diminished after an ether anesthetic if the patient's stomach is washed out on the operating table. The patient's mouth is held open, if necessary, with a gag, and the tube is quickly passed. The point of the tube toward the back of the pharynx and the absence of coughing on the part of the patient is surety that the tube is in the stomach. The patient's head is turned to the side. Often a large quantity of stomach contents is at once regurgitated. The stomach is then washed with warm saline solution until the washings are clear.

(*c*) *Dilation of the Stomach.*—This serious and sometimes fatal complication requires prompt recognition and treatment. It is generally characterized by persistent vomiting, generally of dark brown color. Sometimes, however, there may be no vomiting, but mere distention of the abdomen with increase in the pulse rate. The abdominal distention may be mistaken for tympanites and treated by ill-advised stuping and enemata. In all suspected cases the stomach-tube should be passed. Where the diagnosis is confirmed by the finding of an accumulation of fluid within the stomach, the latter should be kept empty by lavage. The lavage should be done very three or four hours, or even every hour, night and day, until the washing remains clear.

To properly perform lavage a certain amount of skill and tact is necessary. The intern should first explain to the conscious patient that while the lavage is disagreeable it is by no means insupportable, and that the greater the degree of co-operation, the less discomfort he will have. The patient is properly draped about the neck in a rubber sheet and a towel. The lavage-tube has been prepared by the nurse so that it is immersed in ice-water. Some surgeons advise lubricating it with glycerin before passing it. The patient may be propped up on a moderately elevated backrest and instructed to open his mouth. The tip of the lavage-tube is placed back in the posterior part of the pharynx, with the inclination downward. The patient is instructed to swallow, and as he does so, the tube is rapidly forced down the esophagus until the proper black line marking reaches the incisor teeth of the mouth. Many patients at this juncture will think that they are becoming asphyxiated and will attempt and often succeed in withdrawing the tube. If they are assured, however, that breathing is possible; particularly if they breathe in short breaths, they will be induced to lie quietly while the lavage is continued. When the black line on the tube is opposite the mouth the tip of the tube is in the stomach. In cases of dilatation of the stomach with marked retention of fluids there will often be a profuse gush of bile-stained and ill-smelling fluid from the end of the tube when the tip enters the stomach. At all events, when the tip is in the stomach an aspirating bulb should be attached to the outer end and efforts made to aspirate from the stomach any fluid which may be there. When the stomach is empty the aspirating bulb is filled with warm dilute solution of sodium bicarbonate and is attached to the stomach-tube. The solution is gently forced into the stomach and is immediately reaspirated. In place of the aspirating bulb a funnel may be attached to the outer end of the lavage-tube and the soda solution poured in by means of a pitcher. The aspiration of the stomach by this method is accomplished merely by lowering the funnel below the level of the stomach, when the siphon action causes the emptying of the stomach through the lavage-tube. It may be necessary to withdraw and insert the tube a little to insure free flow. In order to prevent the spilling into the trachea the contents of the lavage-tube when it is removed, the tube either should be squeezed or, preferably, should be attached to the continuous suction of the aspirating bulb. Several quarts of warm soda may be required before the stomach washings become clear. In small children a smaller size lavage-tube will be necessary. In unconscious patients the head will be turned to the side, and similar care will be observed in the withdrawal of the tube not to permit the stomach contents to enter the trachea.

The quantity of fluid removed by the stomach-tube is greatly in excess of the usual intake. An intake and output chart must be kept up and the deficiency supplied by hypodermoclysis and proctoclysis.

(*d*) *Hiccough* occurs most frequently in cases in which the abdominal viscera and their peritoneal coverings are involved, and in cases of brain and spinal-cord lesions.[1] It is fairly frequent after operation on the gall-bladder and stomach, and is more common in men than in women. The surest treatment is gastric lavage, although in severe cases alcohol injection of the phrenic nerve has been used. Ghose[2] treated successfully a case of persistent hiccough by injections of ½ per cent. novocaine into the phrenic nerve.

(*e*) *Backache.*—During the operation if the back is protected by placing a small pillow under it, the postoperative backache will be much lessened. After operation the electric pad is very useful.

(*f*) *Gas-pains.*—Postoperative gas-pains are greatly minimized by gentle handling of the intestines during the operation. After operation the rectal tube and, where there is no contraindication, external heat to the abdomen in the form of hot turpentine stupes, or the electric pad are useful. Opiates are contraindicated because of their deterrent influence on peristalsis. If absolutely necessary, heroin and codeine are to be preferred.

(*g*) *Ileus.*—This may be paralytic or mechanical. In the early period when ileus is suspected, a useful diagnostic procedure is that of Webb.[3] Powdered charcoal, about 1 ounce thoroughly mixed with water, may be given by mouth or it may be left in the stomach after lavage, either with or without an ounce of castor oil. The powdered charcoal is inert and absolutely harmless. When it is recovered in the stool after a few hours it is unmistakable, and the surgeon will know that at least there is not a complete obstruction. In the former case the measures to be tried are: Copious and continual hot stupes, various types of enemata (soapsuds, "1–2–3" [glycerin, 1 part; magnesium sulphate, 2 parts; and water, 3 parts], milk and molasses, oxgall and turpentine, etc.), and, as suggested by Dr. Carl B. Davis of Chicago, a senna infusion enema. Pituitrin has been somewhat disappointing. It may be given in three doses of 1 ampule each, fifteen minutes apart. Eserine sulphate, 1/25 grain, hypodermically every three or four hours, is probably the most useful of the drugs. Although Selinger[1] says that postoperative catharsis has been abandoned, and this is nearly correct in certain cases of paralytic ileus, the administration of a dram of milk of magnesium every three or four hours has a distinct value. Even castor oil may be left in the stomach after a lavage. In cases where these measures are unsuccessful, and in all cases of mechanical ileus, a jejunostomy is indicated.

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[1] Lewis, Dean: Boston Med. and Surg. Jour., 1926, 194, 913.

[2] Ghose, D. M.: Indian Med. Gaz., 1926, 59, 124.

[3] Webb, R. C.: Journal-Lancet, May, 1921.

Vogt[2] advises an intravenous infusion of pituitrin saline solution in the treatment of postoperative intestinal paralysis. After the introduction of the needle from 50 to 100 c.c. of normal saline solution is permitted to flow out first and then 4 or 5 ampules of pituitrin are added, averaging 1 c.c. of the latter to 500 c.c. of the saline solution. Throughout the infusion the patient's pulse, repiration, appearance, and condition are closely observed. In favorable cases the skin becomes pale and the features pinched, the eyes protrude, the pulse becomes fuller, and the blood-pressure increases, but all of these phenomena soon disappear. However, if there is a sense of constriction in the chest, dyspnea, or retching, the infusion must be stopped or continued only very slowly and the heart stimulated. From five to seven minutes after the first vasomotor reaction peristalsis begins with emptying of the bowels and great relief. After forty-eight hours at the latest the cannula is removed from the vein.

When the vasomotor reaction does not occur promptly, 1 or 2 more ampules of pituitrin are added to the solution until possibly a total of 8 ampules have been added.

When peristalsis fails to occur even after gentle massage and the application of heat, the introduction of a well-lubricated rectal tube may prove effective. When this fails, the author repeats the pituitrin infusion after a period of twelve hours, although with each repetition the danger is very greatly increased. In quite refractory cases 1 or

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[1] Selinger, H.: Amer. Jour. Surg., 1926, n. s. i, 208.

[2] Vogt, E.: Münch. med. Wchnschr., 1926, 73, 1509.

2 c.c. of practically undiluted pituitrin is injected intravenously as near the infusion needle as possible.

In peritonitis the first measure is gastric lavage, at the end of which 2 tablespoonfuls of castor oil are left in the stomach. When the patient has recovered from this procedure the infusion treatment is given. When, after improvement, there is a relapse, the procedure may be repeated twice with hopes of ultimate success.

As an accompanying phenomenon, rigor is no cause for a pessimistic prognosis. The author has never known of the occurrence of thrombosis or embolism in such cases. Successful results with the method rule out mechanical obstruction of the intestine. The pituitrin works like adrenalin, but its action is slower and more lasting. The normal saline solution dilutes the toxins in the blood, and the detoxication is helped by sweating. Digitalis and insulin may also be used. This method was used when, with the usual methods, there had been no bowel movement for three or four days after operation.

In peritonitis some surgeons place their chief reliance on morphine and the pushing of fluids.

(*h*) *Pain.*—For immediate postoperative pain there is no better drug than morphine. One-sixth to $\frac{1}{4}$ of a grain of the sulphate may be given every six hours for two or three doses. In many individuals there is a distinct increase in nausea following morphine, and the patient would rather endure the pain than use it. A very useful combination is a capsule containing 5 grains of aspirin and $\frac{1}{2}$ grain of codeine sulphate, or better, codeine alkaloid. This capsule may be given as often as every four hours. Heroin, grain $\frac{1}{12}$ hypodermically, is very useful.

(*i*) *Alkalosis.*—According to Moynihan[1] alkalosis is more rarely a cause of anxiety. It may be caused by excessive overdosage with alkalies, and may occur also in gastric disorders in which free hydrochloric acid is diminished, and in hypernea due to increased pulmonary ventilation with excessive loss of carbon dioxide. It is best treated by the intravenous administration of saline solution every eight hours. A weak hydrochloric acid solution may be beneficial.

(*j*) *Postoperative Pneumonia.*—The prophylatic treatment is important. The patient's body should be protected from becoming chilled before, during, and after the operation. He should be protected from the apiration of vomitus. In this condition the co-operation of the medical man is needed.

(*k*) *Cough.*—Coughing is extremely annoying and painful to the patient. Useful measures in combating it are elevating the backrest

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[1] Moynihan, Lord: Lancet, 1926, 211, 789.

6 to 12 inches, the administration of codeine, either alone, with aspirin, or with the elixir of terpin hydrate. A very valuable measure is the use of continuous inhalations of compound tincture of benzoin in steam.

(*l*) *Sleeplessness.*—Where sleeplessness does not arise from pain, luminol, grains $1\frac{1}{2}$, allonal (Roche), grains $5\frac{1}{3}$, or a combination of 5 grains each of veronal and sulphonal are useful.

(*m*) *Embolism.*—This disaster, which can be neither prevented nor treated, is not invariably fatal.

(*n*) *Anxiety.*—This definite entity deserves the surgeon's careful attention. Calm reassurance and a little intelligent psychotherapy will do wonders.

(*o*) *Psychoses.*—Volkmann[1] says that the incidence of postoperative psychoses is about 0.2 per cent. It is more common in males than in females. The treatment is symptomatic.

(*p*) *Anuria.*—*Retention of urine* in the urinary bladder is a very common complication of operations. In females catheterization should be done promptly for discomfort and in all cases where the success of the operation may be endangered by distention of the bladder. In the male all resources should be exhausted before catheterization is resorted to. Warm fomentations to the perineum, permitting the patient to hear the sound of running water, hot enemata, and even, in the case of appendectomies with a muscle-splitting incision, permitting the patient to stand beside the bed. Catheterization in the male, if necessary, should never be delegated to an orderly, and should be done with the utmost attention to aseptic technic. Retention of urine frequently follows the administration of large doses of morphine (codeine, pantopon, etc.), but until recently no effective measure to overcome it has been known. The recent studies of Reimer[2] have thrown considerable light on this subject. In research undertaken at the Pharmacological Institute of Vienna it was found that the effect of morphine on the bladder consists in relaxation of the detrusor. As the result of this relaxation and a simultaneous rise in the internal pressure of the bladder the sphincter undergoes a strong reflex contraction. Potassium salts were found to contract the relaxed detrusor, and to cause the overcontracted sphincter to relax.

The findings made in the experiments on animals were applied in the cases of thirty-four men and fifteen women, with surprising results. The medicament used in these cases was liquor potassii acetatis, given at first in a 20 : 300 solution and then in double that strength. In the cases of patients without gastric symptoms, such as nausea or vomiting, it was given by mouth, but in the others it was administered by rectum. When retention of urine was manifest, a tablespoonful of the solution was given.

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[1] Discussion of Rost's paper, 51 Tag. d. deutsche Ges. f. Chir., Berlin, 1927.

[2] Reimer, H.: Zentralbl. f. Chir., 1924, 51, 1121.

In 80 per cent. of the cases the patient became able to urinate without difficulty within the next thirty minutes. In 9 cases the medicament required a longer time for its effect (up to three hours) and a tablespoonful of the 20 : 300 solution was given every half hour. When the solution was given by rectum its action was somewhat slower. The rectal dose was usually double the dose given by mouth. All of the patients tolerated the treatment well and none of them showed any secondary effects. (See p. 336 for Glycerin Treatment.)

(*q*) *Suppression of Urine.*—Failure of the kidneys to secret urine is an extremely serious complication. The diagnosis is made by the demonstration of anuria which is unrelieved by catheterization. The treatment to be tried is induction of diaphoresis and phlebotomy.

(*r*) *Surgical shock* is that condition in which the patient presents a rapid thready pulse, cold extremities, low blood-pressure, shallow respirations, and partial to total loss of consciousness. Pallor is generally present. The surgical shock may follow operations which may not involve any considerable loss of blood, but the addition, however, of any considerable hemorrhage greatly predisposes toward the occurrence of surgical shock. Severe injuries, such as crushing of the abdomen or extremities, or even of the testicles, will cause shock.

Cope[1] says that there is an unfortunate lack of agreement among surgeons as to what does and what does not constitute shock and collapse. This author says that the symptoms of shock may be attributed to: (1) Circulatory failure, (2) depressed metabolism, and (3) sympathetic stimulation. He points out that the essential diminution of circulating blood in shock need not for some time be accompanied by a lowered blood-pressure. The symptoms of this condition may be very variable even as regards the pulse.

The prompt recognition of shock and the immediate institution of proper treatment is extremely important. Moreover, patients who are admitted to the hospital following severe injuries in the state of shock should be treated for the shock *before* the indicated surgical procedures are taken.

In the prophylactive treatment of shock the operating room should be kept warm, anesthesia should be light and of as short a duration as possible, the viscera should be exposed and manipulated as little as possible, and as little blood should be lost as possible.

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[1] Cope, Zachary: Proc. of the Roy. Soc. of Med., 21, 599, February, 1928.

The *treatment of shock* is as follows: (*a*) External heat. The patient is placed in warm blankets and hot-water bottles or electric pads are put at the extremities, great care, however, being taken not to burn the unconscious patient. (*b*) The foot of the bed is raised 10 to 16 inches in an effort to relieve the temporary cerebral anemia. (*c*) Fluids are administered by all possible routes, by the mouth if possible, by hypodermoclysis, by proctoclysis, or by infusion. Selinger[1] advises the immediate infusion of 1000 c.c. of normal saline solution containing 100 grams of glucose and 15 minims of 1 : 1000 adrenalin or 1 c.c. of pituitrin. A retention enema of 6 ounces of black coffee, with 2 ounces of brandy, at a temperature of 110° F. is useful. (*d*) Various drugs will be useful; aromatic spirits of ammonia by inhalation, caffeine sodium benzoate, $7\frac{1}{2}$ grains by hypodermic, and camphorated oil by hypodermic. It is possible that 1 ounce of whiskey by mouth will have a beneficial effect in patients who are accustomed to taking whiskey. (*e*) In cases where there has been a serious loss of blood, blood-transfusion will be indicated.

(*s*) *Postoperative Rupture of Abdominal Incisions.*—This unfortunate complication has usually been attributed to the giving away of sutures, unusual strains, infection of the wound, failure of the healing process (predisposition, age, disease, etc.), or to the formation of a hematoma. Freeman[2] has reported the results of experiments on dogs in which he offers an explanation for the postoperative rupture of abdominal wounds. He believes that it often results from the inadequate closure of the peritoneum. "Between the loose stitches the omentum (or, occasionally, the bowel) forces itself and, in swelling, acts as an expanding wedge which forces the tissues apart and prevents proper union, the process being aided by serous exudation or, perhaps, suppuration. A rupture may then be precipitated by the strain of vomiting or distention, especially when the fascia is involved. Massive adhesions and many postoperative hernias are similarly explained by subcutaneous wound rupture, which is more common than complete rupture."

(*t*) *Fecal Impaction.*—Occasionally where there has been an absence of a bowel movement for a number of days or a week or more, despite vigorous enemata, the patient will be unable to expel the fecal mass. This is particularly likely to occur in patients who went on the operating table in a constipated condition. Where this condition is suspected, the gloved and well-lubricated finger is inserted into the rectum, and if fecal impaction be encountered, it will be broken up. Occasionally it will be possible to extract the hard masses digitally (Fig. 451).

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[1] Selinger, J.: Amer. Jour. Surg., 1926, n. s. i, 208.

[2] Freeman, L.: Arch. Surg., 1927, 14, 600.

(*u*) *Pleurisy.*—When this condition is present, as evidenced by a painful cough and the auscultation of a pleural friction rub, the chest will be properly strapped with adhesive plaster.

(*v*) *Wound Infection.*—If a clean wound became infected, a culture should be made as soon as pus or other signs of infection appear. If it is simply a small stitch abscess, the removal of two or three stitches will generally remedy the condition. A wound may show a painful red swelling as late as two or three weeks after the operation. Such a swelling may discharge itself spontaneously, or it may require incision and drainage to evacuate a few drops of pus and generally a catgut ligature knot. This is particularly likely to happen if knots of absorbable material are placed too near the skin surface. In more extensive wound infections hot boric fomentations are utilized for a few days. In wide-open wounds with extensive infection the Carrel-Dakin treatment may be indicated. (See p. 61.)

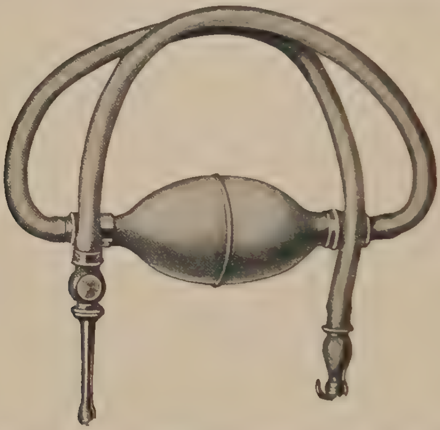

Fig. 451.—Davidson's syringe, helpful in washing out feces after the impacted mass has been broken up with the fingers, spoon handle, or gouge through a proctoscope. (From Gant, "Diseases of the Anus, Rectum, and Colon.")

(*w*) *Postoperative Hemorrhage.*—If the bleeding is at an accessible place very slight pressure will control it. If the bleeding is inaccessible it should be exposed by reopening the wound, if necessary, and ligating or packing the bleeding point. In cases of oozing from an extensive surface and in cases of hemophilia "Fibrogen" (Merrill), by mouth or by hypodermic, will be of value. If a hemostatic serum be employed it is of the utmost importance to first question the patient or his family as to the possibility of sensitivity to horse-serum.

5. **Surgical Dressings.**—The surgical intern will most carefully perform those dressings which are delegated to him. He will strive to acquire a good surgical technic of his dressings. He will never allow his fingers to become saturated or even contaminated with a purulent discharge from dressings. All manipulations or procedures in a dressing should be done with two hemostats or forceps, one in each hand. Sterile gloves will be worn if the wound or any part of the dressing must be touched. The bed-clothing of the patient will be turned back so as to give access to the dressing. If the dressing be fastened by adhesive plaster, in sensitive patients it will be well to cut the adhesive plaster at the edge of the dressing, leaving attached to the skin the ends of the plaster. Fresh adhesive may be placed on top of these ends until finally they are all removed at one time. In less sensitive patients the adhesive will be removed. The proverbial quick jerk is not always wise, as small portions of the superficial epidermis may be torn off. It is better to pull the skin away from the adhesive, as the latter is gently peeled off. It is to be remembered that certain patients are extremely sensitive to adhesive. The patient should be reassured that the intern will do all possible to minimize his pain, and he should give ample signs of that caution.

After the bed-covers have been turned back to expose the dressing and the top dressing has been removed, either by clipping or removing the adhesive fastening or untying the tape adhesives, a sterile towel is laid over the bed-clothing immediately below the dressing. The edge of this towel next to the dressing is turned under the bed-clothing. In removing the dressing next to the skin it will be well to peel it off from the bottom upward in a direction that parallels the incision. The nurse assisting at the dressing will then place upon the towel the requisites of the dressing, several dry gauze pledgets, several flat sponges, and possibly several sponges saturated in alcohol. The nurse will then hand to the doctor two hemostats or tissue forceps. It is better to hand these to the doctor rather than to place them upon the sterile towel. In case the latter has been done, however, a hand should be placed under the towel to lift the handle of the forceps upward, so they may be grasped without contaminating the towel. The doctor will perform the entire dressing by means of two instruments and will not touch the skin, wound, or dressing with his hands. A little practice with this method and one will become thoroughly at home with it. By means of the hemostat a pledget of gauze, saturated in alcohol, is passed over the skin all around the wound and a second pledget is sponged onto the wound. Where the *removal of stitches* is indicated the stitches will all be thoroughly sponged with alcohol. Grasping the central portion or knot of the suture, it is clipped with scissors at one side close to the skin entrance. With a quick jerk the stitch is then withdrawn, being careful to pull it across the midline so as to avoid the danger of opening up the wound by the traction (Fig. 452). Where the mattress-sutures have been tied over buttons it will be necessary carefully to lift up the button to clip the suture beneath it. It is generally wise first to remove those stitches which are liable to occasion the least pain. After the sutures have been removed, if bleeding occurs, it will be wise to sponge the wounds made by the stitches until the bleeding has stopped. The entire wound and neighborhood is then again sponged with alcohol or mercurochrome. Sterile gauze is placed upon it by means of the hemostat or forceps and the dressing is fastened in place by adhesive plaster. If the wound is a drained one or has a profuse purulent discharge, a somewhat different procedure is to be followed. The wound and adjacent skin are carefully cleansed with dry and with alcohol-soaked pledgets. If these be too painful in the wound itself, mercurochrome or cotton applicators may be used. Where there is a profuse discharge from a deep cavity, it may be well to irrigate it under very low pressure with a dilute solution of iodine (Fig. 453). The *shortening of drains* in the abdominal cavity is a matter requiring considerable skill and judgment. In most drained cases it is well to shorten the drain $\frac{1}{4}$ to $\frac{1}{2}$ inch daily. Where two or three cigarette-drains have been used, one cigarette-drain is withdrawn entirely at the first dressing. Where at subsequent dressings it is

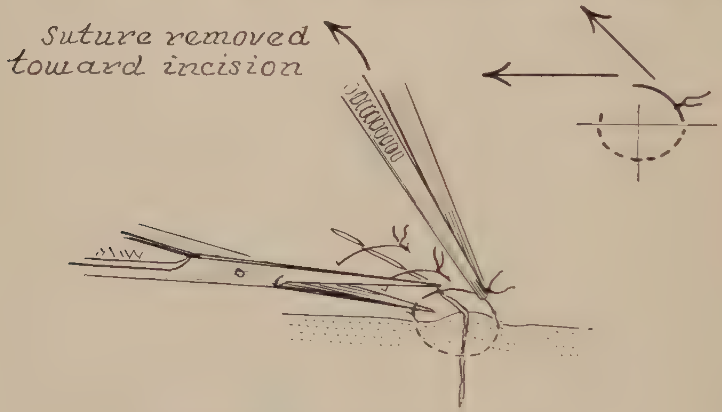

Fig. 452.—Method of removing skin sutures.

thought unwise to shorten the drains, it will be well to give them a slight twist so as to break up the recent adhesions that have formed to them. Many cases of intestinal obstructions have been caused by the improper management of the drains, and the chief errors which have brought about this cause are the failure to remove the drains daily and leaving them in place too long. When a drain is to be removed or shortened the patient is warned that he will experience pain and to brace himself for it. The hands of a child should always be held. When the drain has been shortened the excess length above the wound should be cut off by scissors. While this is being done the drain at the wound edge should be held firmly by a tissue forceps or hemostat to prevent its accidental withdrawal. The safety-pin should then be replaced in the tube to prevent its slipping back into the depths of the wound. With a little practice these safety-pins may be put in place by the two hemostats without using the hands. Where the drains are composed of thin rubber Penrose tubing only, there is some danger of their breaking on being withdrawn, particularly if they have been improperly sterilized. To avoid this difficulty Charnock[1] advises sewing a seam

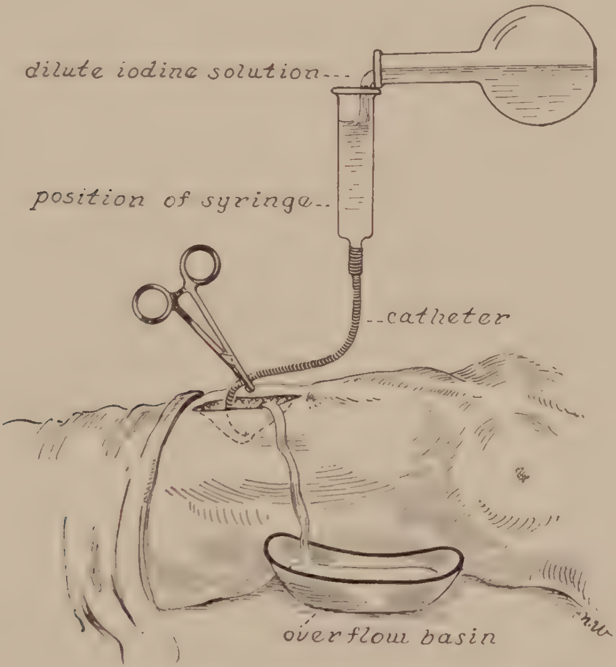

Fig. 453.—Method of irrigating an infected wound.

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[1] Charnock, D. A.: Jour. Amer. Med. Assoc., 92, 982, March 23, 1929.

down the center of the drain with a sewing machine before it is placed in the wound. In cases where the discharge from the wound is extremely irritating to the skin, as in gastric or duodenal fistulæ, it may be necessary to place into the wound a small rubber tube connected with a continuous suction device so as to prevent any discharge from reaching the skin. In a case of colostomy wounds, after the skin has been thoroughly cleansed with alcohol and has been dried, it will be anointed with zinc oxide or vaseline.[1] A mixture of equal parts of ordinary rubber cement and ether has been recommended (Webb). The intern or doctor doing dressings can greatly win the esteem of the patient by the care, gentleness, and patience with which he does the dressings. It is desirable for the intern to do all his dressings as early in the day as possible. Excess granulation tissue will be removed by scissors and the wound thus made cauterized with silver nitrate. Where the excessive granulation tissue is small in amount it may be removed simply by cauterization with silver-nitrate stick (Fig. 454).

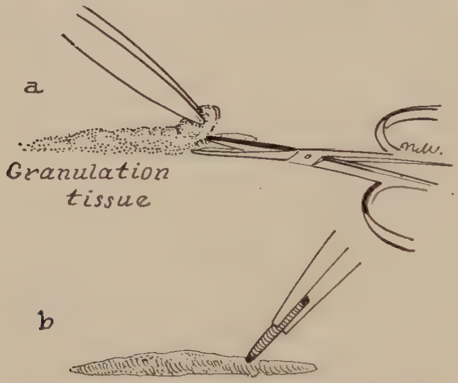

Fig. 454.—Removal of granulation tissue. *a*, By scissors; *b*, by silver-nitrate stick.

6. **Records.**—It is the duty of the intern to see that the records of the cases are in proper shape. The history and physical examination have been mentioned previously. In the proper place in the patient's chart the intern will from time to time (daily in serious cases) make a brief note of the progress of the case. These progress notes are invaluable when a later study of the case is to be made. Removal of stitches, removal of drains, changes in apparatus, treatment of complications, changes for the better or worse in the patient's condition are all to be recorded. Consultants had best make their own notes in the charts, but where they have failed to do so the intern should endeavor to put down the substance of their opinions. All examinations

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[1] See Amer. Jour. Surg., January, 1929, 89, 61.

of the urine, blood-counts, and other laboratory work should be recorded on the chart by the one who made them. Where pertinent, a rough sketch will greatly add to the value of the record. A note as to the condition of the patient on discharge is very valuable.

7. **Laboratory work** is not only a duty of the intern but it is also a very valuable part of his training and experience. The examination of routine specimens of urine in a considerable number will familiarize the intern with all of the normal and most of the abnormal urinary constituents. With systematization of effort and industry large numbers of urines may be accurately examined in a very short time. The making of red and white blood-counts and hemoglobin estimations and differential blood-counts should become a task of second nature and great ease to the intern. He should always have the pipets, diluting fluid, and lancet close at hand. Moreover, he should become thoroughly conversant with the tests for examination of the spinal fluid, with the methods of grouping blood for donors (see p. 597), with the examination of stomach contents, stools, and the examination of blood for parasites. He should be familiar with the making of cultures and smears and with their examination for the commoner micro-organisms. No intern should leave a hospital without being able positively to identify the gonococcus, the tubercle bacillus, and diphtheria bacillus, streptococci, and staphylococci.

The smear is still the most reliable criterion of gonorrheal infection, but cultures will be consistently positive if the material is obtained in the acute stage of the disease.[1] The smears in suspected cases in the female should be taken with a good light and with adequate nursing assistance. Material should be obtained from the vaginal introitus, by expression of Skene's and Bartholin's glands, by expression of the urethra by a finger in the vagina, and from the cervix itself by means of a vaginal speculum. Smears are best made by evenly rolling (not rubbing) slender sterile cotton swabs over sterile slides.

Persistent intracellular, Gram-negative, biscuit-shaped diplococci in freshly made and carefully stained films from the genito-urinary tract of a child are presumptive evidence of gonococcal infection, even in the absence of confirmatory clinical and cultural findings.

8. **Minor Surgical Procedures.**—The minor surgical procedures which have been described previously will, from time to time, become the duty of the intern. He will perfect himself in their performance, so that they may be done efficiently, expeditiously, and with as little as possible discomfort to the patient.

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[1] Scudder, S. A.: Jour. Urol., 1925, 14, 429.

9. **Accident Ward and First Aid.**—The intern will be on constant call for duty in the accident ward. The most important part of this duty is prompt response to calls for his services. It is part of his duty to see that the accident room is properly equipped with all manner of supplies needed in first-aid work, and to familiarize himself with the supplies which are already there. A sterile set of instruments wrapped in a sterile towel should always be in readiness so as to avoid delay. A tracheotomy set, an intubation outfit, tourniquet, all manner of stimulants should be in readiness. It will be well to have a gallon jar containing the proper amount of powdered tannic acid, so that the mere addition of water will make a $2\frac{1}{2}$ per cent. aqueous solution of tannic acid for use in burn cases. The injured person generally is brought in accompanied by a rather large group of excited relatives, policemen, curious bystanders, and the like. The room should be cleared of these people before any procedure is carried out. The first aims of the intern will be to treat shock and to control hemorrhage if these be present. The diagnosis and treatment of these conditions has been given previously (p. 31). The subsequent duties of the intern will vary entirely with the nature of the case. It is a great temptation on the part of the interns to do more than is justified in their anxiety to "do surgery." In cases of severe injury it is far better judgment to do the minimum necessary for the comfort and safety of the patient, to notify the attending surgeon of the condition of the patient, and to be guided by his instruction rather than to proceed undirected. The many minor injuries, of course, will be treated by the intern without consultation with the attending man, but he should be careful to make a proper record of all that is done.

He should not be guilty of the common error of putting in an inordinately large number of sutures in small lacerated wounds.

Interns should familiarize themselves with the methods of accident work and the best methods of care of wounds before these types of cases present themselves for treatment. They should continuously review in their minds possible emergencies and their treatment.

In addition to the intern's duties in the accident department he may be called upon to assist in the conduct of the surgical out-patient department. Not uncommonly an intern will think that this is a very unimportant and unprofitable duty. In this he is greatly mistaken. The out-patient department is always a very fruitful source of surgical learning. Work skilfully done there is an excellent recommendation for participation in larger and more involved things. The intern, in his anxiety to actually do as much surgery as he can himself, should not make the serious and often disastrous mistake of trying to do too extensive surgical procedures in the out-patient department. Perhaps a good example of this type of case is a tenorrhaphy. To attempt this alone in the out-patient department without good assistance and, perhaps, without adequate anesthesia is poor surgery. It is an operation which requires plenty of time, a good light, and ample assistance. He should participate in the "follow-up" clinic if there be one.

10. **Attendance at Autopsies.**—All autopsies should be attended by interns. The great value in pathological instruction to be obtained from postmortems should be stimulus enough in itself to insure the attendance of the interns. Any intern who does not actively try to be present at all autopsies is under some suspicion as to his real interest and devotion to the study of medicine.

11. **Permission for Autopsies.**—Deaths of patients will very frequently occur when the attending surgeon is not present. It may be when it is difficult to get the attending surgeon's presence at the hospital. It then becomes the intern's all-important duty to secure from the next of kin of the deceased the permission for postmortem examination. This most unpleasant duty will require great resourcefulness and tact on the part of the intern. The grief-stricken relatives must be approached with kind solicitude and the purposes of the postmortem explained. The intern will carefully refrain from any vivid description of the actual postmortem. It will be wise to use such phrases as "the reopening of the wound in order to ascertain if everything possible had been done to prevent the death." The more intelligent type of relatives will be influenced by the argument that the postmortem may reveal information which could be of great benefit to some other patient afflicted with the same condition. One must be sure to stress the point that the individual doctor or intern will probably not personally benefit by the postmortem, but that humanity and society will through the accumulation of knowledge obtained from many autopsies. Most frequently great opposition is encountered in securing permission for postmortems, and the intern may be required to engage in a painful and tedious argument which will require great patience and forbearance. In case he fails to secure this permission, he should try to keep the relatives at the hospital until the attending surgeon may be summoned to add his persuasion to the intern's. Success in obtaining permission is much more likely to occur if the relatives can be approached before they have had conversation with the undertaker. Most undertakers are opposed to postmortems because it delays their work and increases its difficulty, and they will not hesitate

by subtle suggestion to paint the horrors of the autopsy to the relatives.

Christian[1] says ". . . it has seemed to me that the number of necropsies obtained on patients dying in the hospital is perhaps the best single index of the professional efficiency of the hospital, of the amount of work devoted to the study of patients by members of the staff, of the eagerness of the staff to learn, and its teaching abilities."

12. **Societies and Collateral Reading.**—The intern should inform himself as to the literature pertaining to the cases in his care. Even a small amount of well-directed reading will greatly enhance his understanding of the cases and will make more intelligent the measures which he employs in the study and treatment of the case. All first-class hospitals should have at least a small library of standard works and the more important periodicals. He must make it an important part of his program to attend meetings of medical societies and, if possible, to attend other clinics and hospitals.

The interns should make every effort to attend the conferences given by the pathological department. At these conferences, whose preparation entails a great deal of work, the material from autopsies and specimens removed at operation are shown and discussed. Interesting sections of pathological specimens and unusual bacteriological findings are exhibited and explained. Once or twice monthly, in most hospitals, there is a clinical meeting of the surgical staff to which the attendance of the surgical interns is imperative. The preparation of much of these conferences is often delegated to the senior surgical intern. He will ascertain what deaths have occurred on the service since the last meeting; he will find all the most interesting cases; cases having postoperative infections or other complications. He will prepare a list of such cases for the chief of the service and will see to it that all the records, *x*-rays, etc., pertaining to these cases will be present at the conference. The interns will often be called upon to present cases at both the pathological and the surgical staff conferences. If this is the case he should present his case *briefly* and with a good understanding of its essential points. It is very tiresome to have to listen to a long-drawn-out reading of a history and physical examination, or to endure interminable waits while a protracted search is gropingly made through the record for some essential point.

13. **The Intern's Health.**—There is perhaps no other period in the career of a doctor which is more taxing to his health than the internship. Long hours of responsible duties, frequent interruptions of the

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[1] Christian, Henry A.: Jour. Amer. Med. Assoc., 86, 1499, May 15, 1926.

night's rest, and close confinement indoors have impaired the health of many interns. It is an important duty not only to the intern himself, but to the patients as well, that he secure a certain amount of periodical out-door exercise, together with mental relaxation and diversion, and that he does not lose too much sleep in his time off.

III. DUTIES OF AN INTERN TO THE ATTENDING SURGEON

1. **Notification of the Attending Surgeon of a Patient's Arrival at the Hospital.**—As soon as a patient is admitted to the hospital the intern should endeavor to get into communication by telephone with the attending surgeon. In case he is unable to do so, he will have a conversation with the patient and use his best judgment as to the preliminary orders until more specific ones can be obtained from the attending surgeon. Not infrequently unavoidable exigencies will delay the communication between the intern and the attending surgeon. The loyalty of the intern will then demand that he reassure the patient's anxiety as much as is possible. He will try to protect the best interests of the attending surgeon in every way. He will be an attending man himself some day soon.

2. **Rounds.**—The intern will arrange with the telephone operator at the hospital so that he is notified immediately upon the arrival in the hospital of the attending surgeon. He will meet the latter at some appointed place or find him in the wards and make the rounds with him. If he is unavoidably prevented from making the rounds with the attending man it will be courteous to inform the latter to that effect. He should always be provided with a notebook in which to note all directions or suggestions by the attending surgeon as to the patient's care. Changes in orders by the attending surgeon should be written by the intern on the chart or order book. He will be present at most examinations of patients and will observe the manner in which they are conducted. The surgeon will often invite him to inspect or palpate some interesting pathological finding, but he should not crowd forward to do so unless asked. At the conclusion of the rounds the intern will ask the attending surgeon any points in the diagnosis or treatment of the case that are obscure to him, and great profit may result from these discussions.

In the evening, or in the absence of the attending man, the intern will make rounds. He will give serious consideration to each patient's condition and will write such orders as will best promote the patient's comfort and safety and which will be in line with what he knows to be the ideas of the attending surgeon. In case of doubt, or where there is serious change in the patient's condition, he will get into telephonic communication with the attending surgeon. It is a wise rule for the intern in his evening rounds to anticipate, if possible, all the needs of the patient during the night. This will not only give the patient a more comfortable night, but will save the intern from many interruptions to his sleep. Inexperienced nurses will often call an intern needlessly in the night. These calls are based on what the nurse considers a very serious responsibility to her patient and they should be answered patiently and courteously. A sarcastic or impatient answer may have the effect of detering the nurse from calling the intern the next time when he really is needed.

3. **Assistant at Operation.**—Perhaps the chief function of a surgical intern is to assist at operation. The first requisite to this duty is that he be present in the operating room *on time.* It is better that he be there slightly before the attending surgeon and supervise the transportation of the patient to the operating table. A glance at the instruments will not only familiarize him with them, but, by the detection of omissions, may save a considerable loss of time during the operation. The cap or helmet should be adjusted before starting to scrub. The mouth gauze should be so adjusted as to cover the nostrils. In their study of postoperative hemolytic streptococcus wound infections Meleney and Stevens[1] found that 33 per cent. of the operative staff at one time had the hemolytic streptococcus in their throats. The intern will start scrubbing somewhat before the attending surgeon, so that by the time the surgeon has completed his scrubbing the intern will have prepared the field of operation. The hands are thoroughly scrubbed with green soap and water for five minutes. Do not dip the scrubbing-brush back into the receptacle for soap. The soap should be poured on the brush by either pitcher or automatic container. An excellent guide to scrubbing of the hands is a five-minute sandglass placed in front of the scrub sink. At the beginning or the early part of the scrubbing the finger-nails, which should always be short, are thoroughly cleansed by a nail-file which is kept in a dilute solution of lysol. The hands will receive the most vigorous scrubbing, but the forearms should not be omitted. After the scrubbing and frequent rinsings have been completed, and the arms and hands are finally rinsed, the hands will be immersed in a basin of alcohol and the forearms washed by pouring on handfuls of alcohol. This technic varies in different hospitals. The alcohol may be applied to the hands and arms by means of alcohol-soaked

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[1] Meleney, F. L., and Stevens, F. A.: Surg., Gynec., and Obst., 43, 338, September, 1926.

sponges. Lilienthal and Ziegler[1] anointed the hands with a mixture of lampblack and oil. In spite of vigorous and prolonged efforts with green soap and the scrub-brush a black line remained under and around the finger-nails. Other cleansing preparations were used, with the same results. After cleansing, cultures showed that all areas of the hands except the subungual and periungual tissues were sterile. These authors recommend that the perfectly dry finger-tips be immersed in U. S. P. tincture of iodine up to the joint of the terminal phalanx and then allowed to dry for five minutes. At the end of that time the usual scrubbing process is carried out. Bacteriological tests have demonstrated that tincture of iodine thus employed will completely sterilize the spaces about the nails.

The intern then picks up the folded sterile gown and opens it up. It is folded so that the side of the gown which goes next to the person is outermost. The hands are inserted into the sleeves and the gown is partly slipped into. The nurse then draws on the gown from behind and ties it, taking care not to contaminate the front part of the gown. Do not touch the gown with the bare hands. The hands are then dried with a sterile towel and are powdered with talcum powder. There is a right and a wrong way to put on sterile gloves. The gloves should be sterilized with the cuffs turned back. The powder puff should be inside of the glove. After this has been removed and his hands dusted, the intern will grasp the left-hand glove at the edge where it is turned back with the right hand, and draw it on the left hand. He will then place the gloved left hand under the folded cuff of the right-hand glove and draw that glove onto the right hand. The end of the gown sleeve is then folded over and the rubber cuffs drawn over it. In long-armed individuals where the gown sleeve may be too short the wrists are covered with stockinet wristlets. In summer a damp towel tied about the forehead is a great comfort. Interns wearing glasses will be sure that the mouth gauze passes beneath the lowermost rim of the glasses to minimize fogging of the glasses by breath. The mouth gauze should be provided with a flexible piece of metal, usually a strip of lead, sewed in its border to bend over the bridge of the nose to insure a more accurate contact of the gauze with the face.

A second pair of rubber gloves termed the "preparation" gloves will be drawn on over the first pair. These are to diminish the danger of contamination during the process of preparation of the field of operation. The intern will then drop a sterile towel at the side of the patient and between him and the operative field. This is to further minimize chances of contamination. He will be careful not to permit his gown to touch the unsterile drapes or the operating table itself. The nurse will then hold up for the intern the sterile preparation tray on which will be found material for preparing the field for operation. For painting the field of operation a gauze pledget tied to the end of the tongue-depressor is very useful (Fig. 455). Small cups contain the various solutions used in the preparation. Tincture of iodine, 2 and 7 per cent., is most commonly employed. In very delicate skins or about the genitalia the acetone-alcohol-mercurochrome solution is used. The portion of the skin in which the incision is to be placed is first painted, and the adjacent portions in a gradually enlarging field are then treated with the solution. Great care must be observed not to permit the solution to run down in the groins or down the sides of the patient to the back, as troublesome burns may result. Where there is fear that the skin will become burned by the iodine the latter is washed off with alcohol. The prep gloves are now removed by means of the turned back cuff by the nurse; the intern then places four sterile towels on the four sides of the operative field, leaving ample area of the painted skin exposed and being careful not to contaminate his sleeves, hands, or his gown. The "scrubbed" nurse will then put the laparotomy sheet in position. The latter has been so folded and is so placed that the window in it will lie opposite the field of operation. The nurse who places the laparotomy sheet must take care that she does not drag it over the patient's body, because this might carry contamination from unsterile to sterile fields. Lahey[1] has devised a method of clamping operating sheets in goiter and neck operations so that instruments may be prevented from falling on the floor. The Trendelenburg table, or Mayo stand, is placed 8 or 10 inches higher than the patient's shins, over which it rests. The fold of the sterile sheet covering the patient is then fixed by hemostats to the sterile pocket cover over the Trendelenburg table, and the folded portion of the sheet is likewise made fast at the head of the table to the sheet, which is turned upward over the anesthetist's bar. This

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[1] Lilienthal, H., and Ziegler, J. M.: Ann. Surg., 1926, 83, 831.

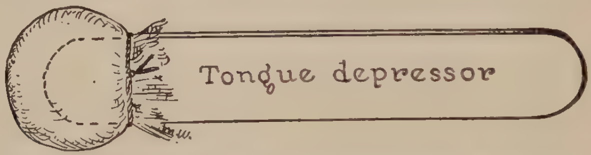

Fig. 455.—Gauze pledget tied to tongue-depressor for applying antiseptic to operative field.

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[1] Lahey, F. H.: Jour. Amer. Med. Assoc., 91, 1108, October 13, 1928.

forms a side wall of sheeting on each side of the patient's chest and abdomen, making a rectangular trough into which instruments and needles readily fall when placed on the patient's body in semireclining position (Fig. 456). The intern should now take his place opposite the operating surgeon. If a second intern is in attendance, his place will be at the right hand of the first intern. If a third assistant be in the operation his place will be at the surgeon's left hand.

The watchwords of good surgical assistants are alertness, accuracy, helpfulness, silence, and avoidance of obstructing the surgeon's efforts. With a little practice the intern will soon learn to anticipate the surgeons' wants without being told. He will always have in his hand a hemostat or a sponge and he will always have the hands usefully occupied. He will be extremely careful not to interpose his hands between the surgeon's eye and the field of operation. He will avoid the bad habit of becoming so interested in the operation as to bend over and interpose his head between the surgeon's eyes and the field of operation. He should not take his eyes out of the wound any more than absolutely necessary. If an instrument is wanted, he should not reach for it blindly on the instrument stand, or ask the nurse for it and extend his hand to receive it. Particularly should he not take his eyes from the wound when one of his hands is holding some piece of tissue or instrument with which the surgeon is working. The momentary deviation of his eyes will

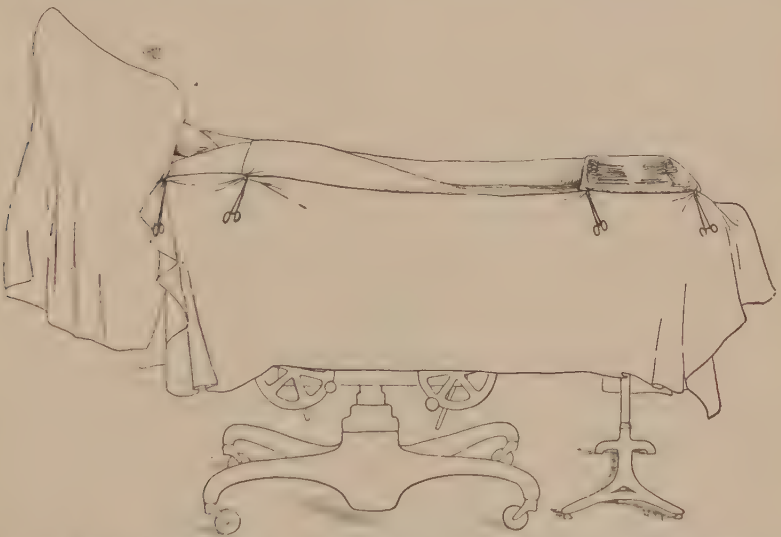

Fig. 456.—Method of clamping operating sheets so that instruments may be prevented from falling. (Lahey, F. H., Jour. Amer. Med. Assoc., October 13, 1928.)

make that tissue or instrument tremble, much to the annoyance of the surgeon and the possible danger to the patient.

The intern should strive to anticipate the surgeon's needs. He will know when to retract without being asked, and will select the proper type of retractor. He will so grasp the retractor that it may be held with a minimum of effort and he will not permit it to slip out of position. When the field becomes obscured by blood the latter will be *sponged* away. All blood should be *sponged* or blotted away and not wiped away. The wiping of an oozing field will destroy the efforts at coagulation and only serve to continue, or to increase, the hemorrhage. The intern should sponge quickly and get out of the wound quickly. The bloody sponges should be placed in the proper receptacle. The intern should be extremely gentle with all his manipulations. Rough handling with consequent traumatization of the tissues is to be shunned. When the scalpel of the surgeon severs a vessel, either artery or vein, the intern will grasp the cut ends with a hemostat. He should grasp the cut end only, with as little as possible of the adjacent tissues (Fig. 457). In case the bleeder is difficult to grasp, he will assist the surgeon by retracting and sponging in this effort to grasp it. When vessels are to be tied the surgeon will direct who is to tie it. Should he elect himself to do the tying the intern will hold up the handle of the hemostat so as to easily pass the ligature around behind it (Fig. 458). When the ligature has been passed around behind it, the intern will drop the handle and elevate the tip of the hemostat which has grasped the cut vessel in order that the surgeon may have better opportunity to tie the knot (Fig. 459). The intern will not remove the hemostat until the surgeon says, "off." As soon as he has taken off the hemostat he will provide

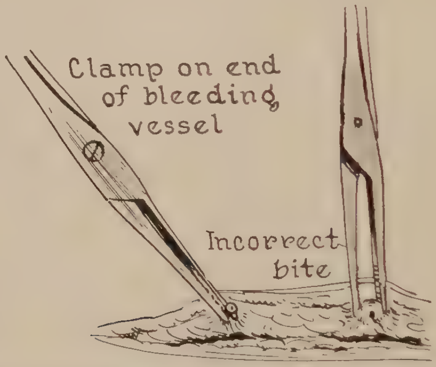

Fig. 457.—Correct and incorrect methods of clamping a bleeding vessel. Too large a bite is not good technic.

himself with scissors and cut the long ends of the ligature to the length indicated by the surgeon. The cutting of these ends must be accurately done. Too long ends are objectionable and too short ends weaken the knot. The intern must observe particular care in cutting a ligature that the points of the scissors do not enter bowel or other important structures. If necessary he should steady the points of the scissors with

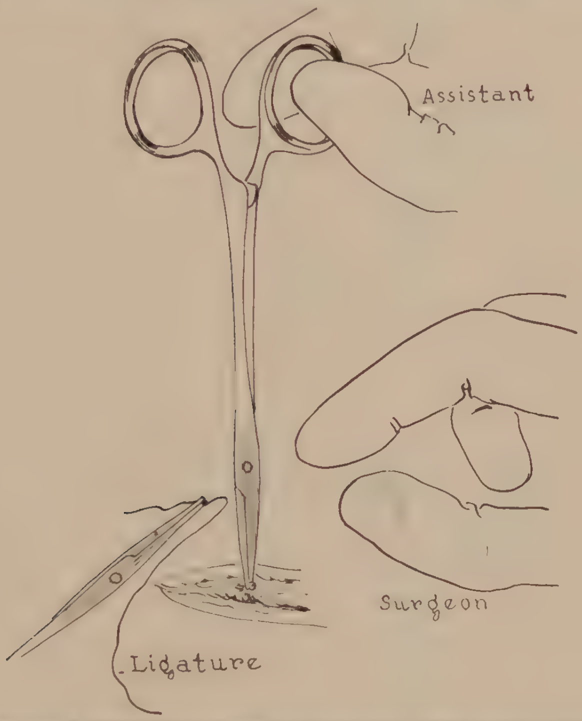

Fig. 458.—Assistant holds clamp on vessel in the vertical position while ligature is passed about it.

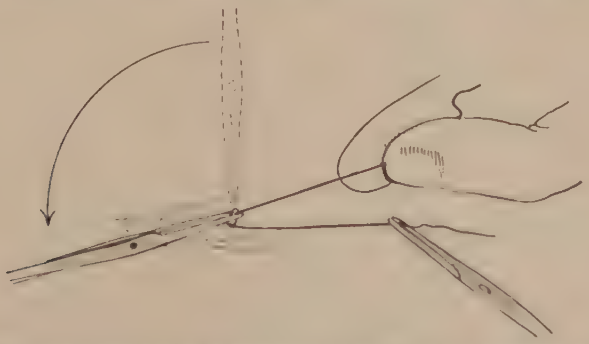

Fig. 459.—When the ligature is to be knotted, the handle of the hemostat is dropped and the point is elevated.

the other hand. The surgeon may elect that the intern tie the ligatures. In this case it is often to the intern's advantage that he learn to tie with a hemostat at one end of the ligature. He should tie square knots only (Fig. 460), and if necessary should practise this procedure with a piece of string outside of the operation time. Meynen[1] has described an excellent method of tying a square knot in which only the right hand is directly used. He describes his methods as follows (Fig. 461):

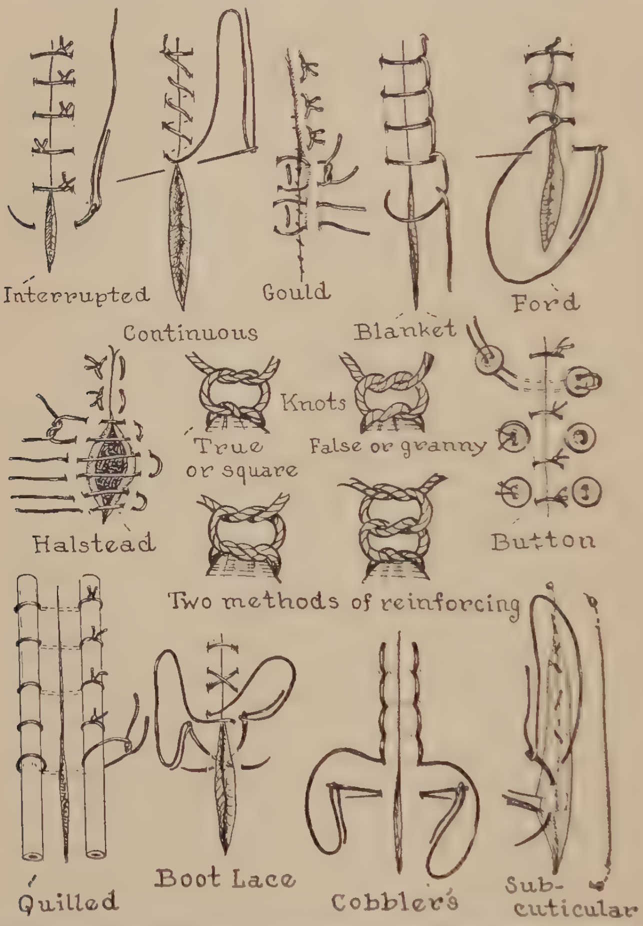
Interrupted
Continuous
Gould
Blanket
Ford
Knots
True or square
False or granny
Halstead
Button
Two methods of reinforcing
Quilled
Boot Lace
Cobbler's
Sub-cuticular

Fig. 460.—Various types of knots and sutures. (After Tom Jones, Luken's Suture and Ligature Manual.)

"It is essential to remember that the long end (if there is a choice) should always be grasped by the left hand. In the drawings, for the sake of simplicity, the long end is left free without indicating the left hand.

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[1] Meynen, F. G.: Jour. Amer. Med. Assoc., 85, 579, August 22, 1925.

"Assuming that the long end comes out of the wound on the far side from the surgeon about to tie the knot (as is the case, for example, when the first knot in a continuous suture is tied by an assistant for the operator), it is grasped by the left hand, while the short end is grasped about 1 inch from the end between the thumb and index-finger of the

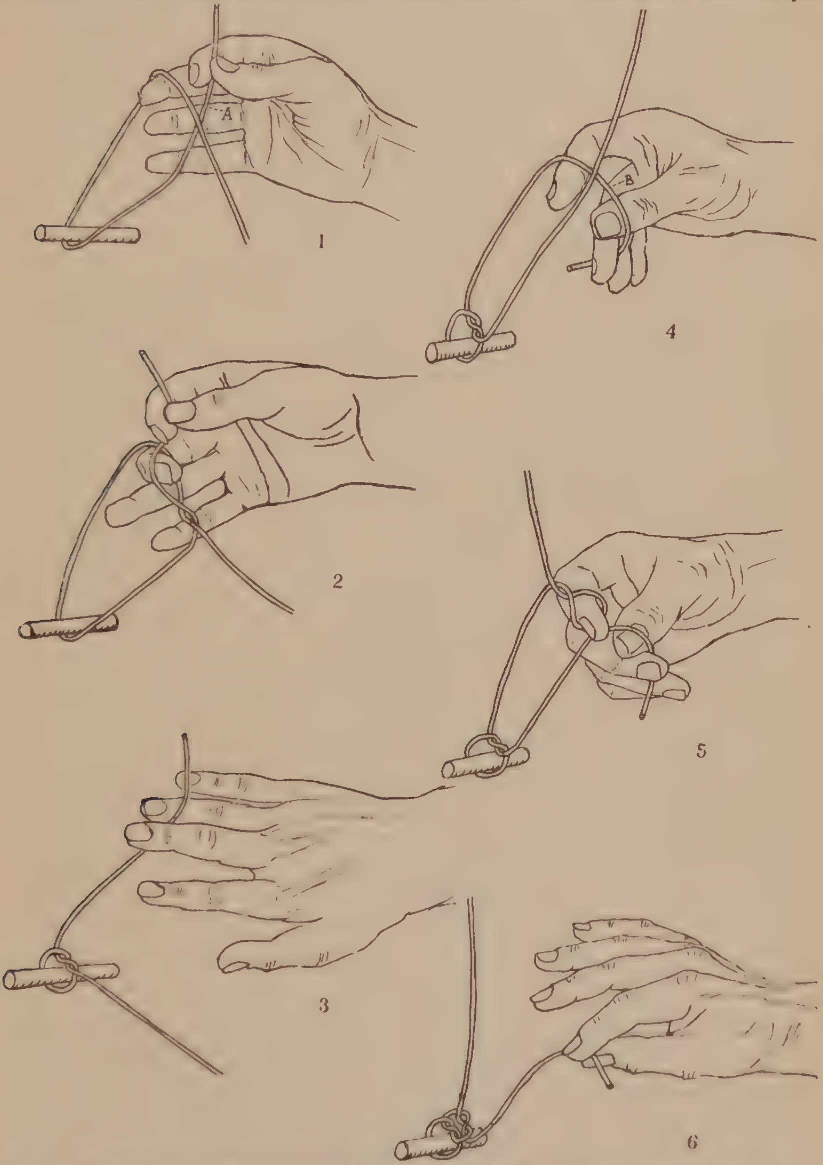

Fig. 461.—Steps in tying one-handed knot. (Meynen, F. G., Jour. Amer. Med. Assoc., August 22, 1925.)

right hand with the palm down. The palm is immediately turned upward with the suture lying across the fingers and the longer end brought into the position shown in Fig. 461, 1. The middle finger is then hooked under the portion of the suture marked *A*, as in Fig. 461, 2; this is drawn through the loop by grasping it between the middle and ring fingers, and first single knot drawn tight as in Fig. 461, 3. The same firm grasp being kept with the middle and ring fingers, the palm is turned somewhat upward, the thumb and first finger being placed

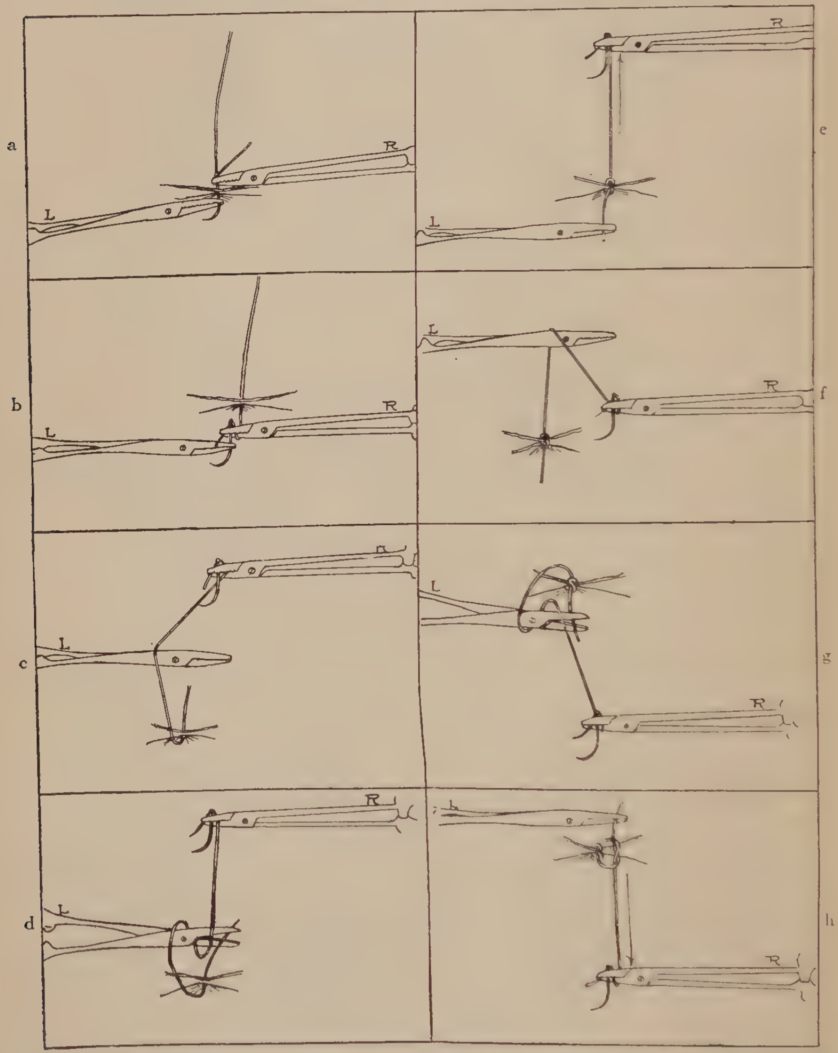

Fig. 462.—Tying square knot by means of instruments. (Livingston, Edward M., Amer. Jour. Surg., February, 1929, Paul B. Hoeber, Inc., Publishers, N. Y.)

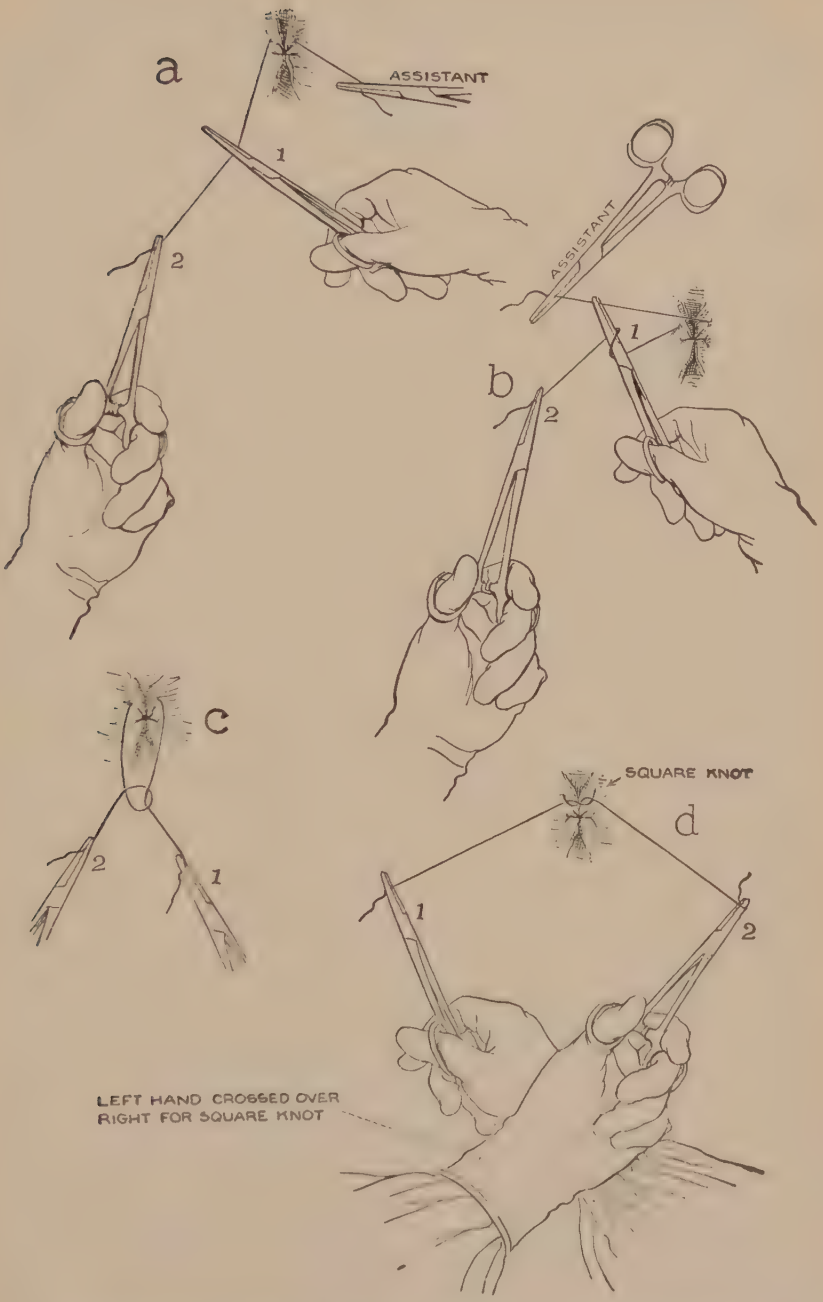
a
ASSISTANT
1
2
ASSISTANT
b
1
2
c
2
1
SQUARE KNOT
d
1
2
LEFT HAND CROSSED OVER
RIGHT FOR SQUARE KNOT

Fig. 463.—Tying knots without use of fingers. (From Forrester's "Imperative Traumatic Surgery," published by Paul B. Hoeber, Inc.)

under the suture and the long end in the position shown in Fig. 461, 4. The tip of the index-finger is then hooked under the portion marked *B*, as in Fig. 461, 5, drawing it through the loop and grasping it between the thumb and index finger as soon as it is through, and the knot is drawn tight and completed as in Fig. 461, 6. Should a third knot be desired, the hand will be found in a position ready to repeat the first maneuver from Figs. 461, 1–461, 3.

"Should the surgeon be desirous of tying his own suture (in which case the short end will come out on the far side of the wound and the long end on the near), he has only to begin with the maneuvers depicted in Figs. 461, 3–461, 6 and end with Figs. 461, 1–461, 3.

"This method is particularly suitable and rapid for ligating vessels with a long ligature wound around the fingers of the left hand. It must be remembered, however, to begin with Fig. 461, 1, when the long end comes up on the far side of the clamp, and with Figs. 461, 3–461, 6, and then Figs. 461, 1–461, 3, when the long end comes up on the near side of the clamp. This decision will come instinctively with practice." Many interns and surgeons have become extremely proficient in the tying of one-handed knots, a procedure which shortens the operation time.

It is extremely valuable to learn how to tie knots with instruments only (Figs. 462, 463). The intern will not place his hand in the abdomen to palpate pathology unless invited to do so by the surgeon. In appendectomies where the appendix is removed with inversion of the stump, the intern will be careful not to lose control of the stump prior to its inversion. The intern will be on the alert to grasp the surgeon's needle after the point of it has projected through the tissues, particularly when this occurs in the depths of the wound or in some inaccessible place. Penfield[1] has devised a simple needle-pulling forceps. It is a saddle-shaped piece of metal which may be attached to the operator's favorite thumb forceps. It is particularly useful for the surgeon himself, who holds it in his left hand as he sews (Fig. 464). For the intern an extra needle-holder is useful for this purpose.

After the incision has been made and preliminary hemostasis secured, towels will be clamped into the wound margins. This preferably is done by laying the towel at the edge of the wound, so that the body of it lies across the wound. The towel itself is then fastened into the wound by proper towel clips and is then turned back over so that the clips are covered and so that the towel actually extends into the wound. The same procedure is carried out on the opposite edge of the wound and the two towels are clamped together at the

[1] Penfield, W.: Jour. Amer. Med. Assoc., 91, 1187, October 20, 1927.

ends of the wound by a hemostat placed beneath them. An excellent new towel clamp has been devised by Nauth. The construction and application of this clamp will be obvious from Fig. 465. When the surgeon is closing the peritoneum or the fascia the intern will keep a constant tension on the suture, so that the stitches already placed will not be permitted to loosen. Blair Bell[1] has called attention to the fact that a large percentage of incisional herniæ are due to imperfect suture

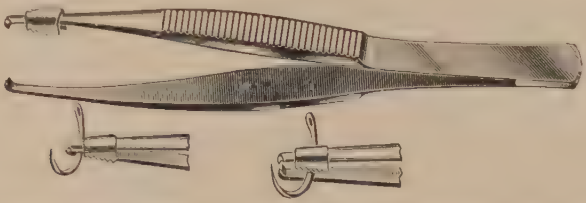

Fig. 464.—Needle-pulling forceps. (Penfield, Wilder, Jour. Amer. Med. Assoc., October 20, 1927.)

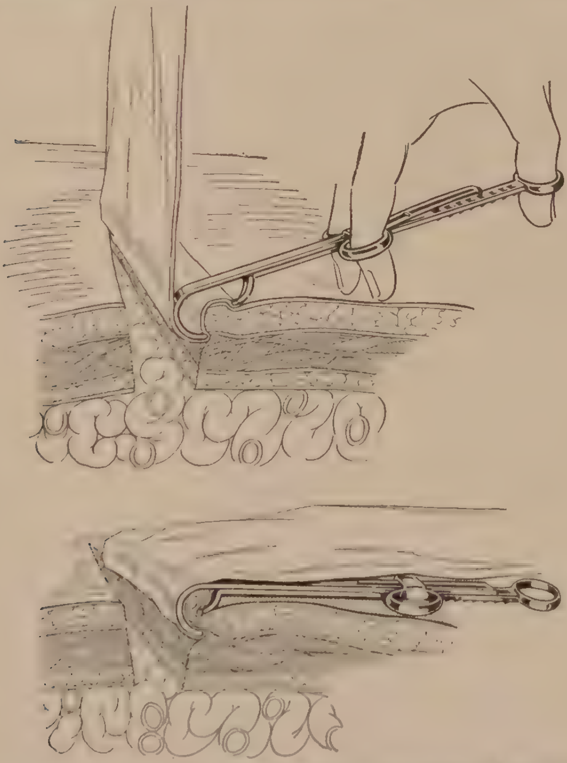

Fig. 465.—Nauth towel clamp. (Nauth, W. W., Jour. Amer. Med. Assoc., July 10, 1926.)

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[1] Blair Bell, W. J.: Obst. and Gynec. Brit. Emp., 1926, 33, 300.

of a laparotomy wound. The essential requirements, apart from asepsis, of a perfect procedure in the closure of an operative opening in the abdomen is given by Bell as follows:

1. The avoidance of apertures through the sutured peritoneum.
2. The prevention of the intra-abdominal adhesions to the back of the scar.
3. The obliteration of all dead spaces.
4. Overlapping closure of the aponeurosis with suitable material.
5. Stay sutures that will keep the aponeurosis closed as it is sutured and which, when tied, will approximate the deeper part of the wound throughout, and will not cut the skin.
6. Neat closure of the skin edges to secure a good cosmetic result.

Difficult closures are greatly aided by intelligent assistance, as proper retraction and the gentle pushing of the abdominal contents back into the abdomen by gauze or blunt instruments.

Should the intern accidentally wound one of his gloves with a needle or otherwise, he will immediately change it. Collins and Ritz[1] made a bacteriological study of surgical infections, and concluded that the chief source of postoperative infections is punctured rubber gloves.

Cheerful co-operation by the intern will make the surgeon's work a pleasure. Grudging and hesitating help may be worse than useless. The intern or nurse should not ask the surgeon what he wants next or what he is going to do next. He or she should be silent but alert.

When the skin is closed, the intern will be sure that there is no inversion of the skin edges. A sterile dressing will be placed upon the skin wound and the excess of iodine at the borders of the dressings will be washed off with alcohol. The intern will then fasten the dressing with adhesive plaster, taking care that the plaster does not pass over the anterior superior spine of the ilium, and that it is not too tightly applied. In drained cases where frequent changes of dressing will be necessary the tape adhesives or laced adhesives will be used (see Fig. 11).

Freeman[2] advises the use of rubber bath sponges to exert a constant pressure for the obliteration of dead spaces, as in cancer of the breast, under the clavicle, and on either side of the neck in goiter. Such sponges may be applied also beneath a binder to press upon and close fecal and urinary fistulæ.

In warm weather the intern will be careful that perspiration does not drop from his forehead on the field of operation. When his forehead becomes moist perspiration should be wiped off by a nurse. In long operations interns have been known to become faint. If he feels this fate impending it will be well for him to excuse himself for a rest rather than stick to it with the possibility of actually fainting.

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[1] Collins, A. N., and Ritz, F.: Minnesota Med., 1925, 8, 181.

[2] Freeman, L.: Colorado Med., 1925, 22, 164.

A word of caution may be spoken as to the danger of slippery floors in the operating room. The writer has seen a broken arm result from incautious haste in an operating room. The unnecessary moving about in an operating room greatly increases the opportunity for accidental contamination. Attention to this point has brought fruitful results. Pool[1] had an architect's plan made of the operating room, and during a standard operation had lines traced on the plan to mark all the steps made by the individuals in the operation. Before his efficiency methods were instituted the complexity of the pattern of these lines was astonishing.

To insure the efficiency and silence in the operating room Pool[2] devised a signal system for securing instruments. The surgeons and assistants signal to the scrub nurse by various positions of the fingers for various types of instruments. This is particularly valuable when local anesthesia is employed.

When operations are performed under local anesthesia an intern is often assigned to the duty of staying at the patient's head and diverting his attention with suitable conversation and encouraging him. Under these circumstances the intern is warned from making tactless remarks, such as "it does not hurt, does it?" An intern's usefulness may be quite accurately measured by his reaction when something goes wrong in the operating room. A large bleeding vessel has escaped control, the trachea is inadvertently opened in a thyroid operation, or the bowel is accidentally punctured. His equanimity and skill will greatly fortify the surgeon in his overcoming the unpleasant situation.

Another duty of the intern is to assist the nurse in accounting for the proper number of laparotomy pads and sponges. An abdomen should never be closed until these have all been accounted for. The writer recalls a case where a well-intentioned spectator at an operation "thoughtfully" removed a laparotomy pad which he found on the floor and, unobserved by any one, carried it into the next room and placed it in the sink. The operating team was subject to a long and unnecessary delay before the missing pad was found. It is important to account for sponges not only in laparotomies, but small gauze sponges may be left in the depth of deep wounds in the extremities, particularly those for the treatment of osteomyelitis. The writer has seen a gauze sponge, which was placed in the vagina to prevent vaginal discharge escaping to the field of operation for hemorrhoids, inadvertently left in the vagina. It was removed many weeks later by the angry patient.

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[1] Pool, Eugene H., of New York.

[2] Ibid.

In case of shock on the operating table, where hot-water bags are placed to the extremities, it must be remembered that the surgeon may be held liable for burns of the unconscious patient.

Where ethylene anesthesia is employed one should be sure that no actual cautery or electrical spark is in the neighborhood because of the danger of explosion. The writer knows of a case where the actual cautery was used on the liver and, perforating the diaphragm, ignited the ether vapor in the lungs, causing an explosion which knocked the anesthetist off his stool, but fortunately did not injure the patient.

4. **Notification of Attending Surgeon of Unfavorable Progress of the Patient.**—The intern should notify the attending surgeon immediately of any unfavorable developments of his patients, no matter how trivial these may seem to be. Well-intentioned interns often may try to spare attending men the bother of telephone conversations and assume more responsibility than is warranted. The intern may be very sure that the attending man will greatly welcome any information of this type.

5. **Operations by Interns.**—Unfortunately many interns judge the value of a surgical service by the number of operations they may actually perform themselves. It is, of course, essential that the intern be permitted to do a certain number of operations whose nature will depend upon the length of apprenticeship which the intern has had, and upon the demonstration of his fitness to do it. By far the most valuable part of a surgical internship, however, is the training of the intern in diagnosis, his education in good surgical methods, his repeated observations of all types of pathology, and his acquisition of the knowledge of how to understand patients and how to deal with them. The mechanical side of operating may readily be acquired by anyone of average deftness. Even the unsteady hand may become a useful operator. As Treves has said, "the shaking hand may be somewhat of an impediment to the completion of an operation, but the shaking mind is hopeless." Where interns are permitted to perform operations, these should always be done with an attending man acting as assistant. This duty of the attending man will be much more tiresome than doing the operation himself, but it is a necessary part of his duty to the intern.

6. **Physiotherapy, Occupational Therapy, and Anesthesia.**—The intern should become thoroughly familiar with the various types of treatment and their indications, which are given in the physiotherapy department. He should instruct himself in the various methods of giving

massage in order that he may be able to give the proper instructions for its administration. He should understand the various uses of diathermy, and should be competent to give a treatment. He should understand the various methods of giving external heat, as the infra-red lamp, radiant heat, hot fomentations, etc. He should understand the uses and the limitations of ultraviolet light therapy. He should understand the treatment of paralyzed muscles by the galvanic and sinusoidal currents.

Moreover, the intern should be fully cognizant of the workings of the occupational therapy department. He should constantly be on watch for types of cases which will be benefited by this department, and should co-operate with the workers in this department in seeing that the most useful type of therapy is given.

And, finally, the intern should learn as much as possible of the administration of anesthesia. In most hospitals at the present time salaried anesthetists are employed who give all the anesthetics. It is desirable that the intern be given some instructions by these anesthetists in the indications and restrictions of the various types of anesthetics. He should know the best type of anesthetic for each type of case and, what is perhaps most important, he should be competent to tell when an anesthetic is being given poorly, and what the proper measures are for remedying the difficulty. In cases of disaster during the anesthetic the intern should understand restorative measures. Lobelin by hypodermic and dilatation of the rectum are respiratory stimulants. On the operating table artificial respiration may be given by slowing drawing both arms high above the head and then slowly bringing them down to the sides so that the elbows are pressed into the sides of the chest. Rebreathing of carbon dioxide and oxygen are useful in cases with embarrassed respirations. Where the breathing is hindered by the jaw dropping, the latter should be pushed forward by placing the thumbs behind *both* angles of the jaws. Pulling up the chin is not nearly so useful. Where the tongue has dropped back it may be pulled forward with an instrument. Often the introduction of an "airway" (a curved metal tube which fits over the rongue) will be of use.

IV. DUTIES OF THE ATTENDING SURGEON TO THE INTERN

The attending surgeon's first duty to the intern is to see that he has the opportunity to learn surgery. As W. Wayne Babcock[1] says, he should give him systematic instruction. "Every patient in the hospital should be accessible to the intern."[2] He should go out of his way to show him interesting pathological conditions and he should explain fully to him the reasons for the various therapeutic measures which he employs. He should stimulate the intern by questions and should encourage him in his collateral reading and attendance at medical societies. He should insure proper discipline among the interns. Careless work or laziness should be censured. He will endeavor to delegate responsibility as far as is possible to the intern. Responsibility increases the self-respect of the intern and his capacity for original thought. In his relation to patients the attending surgeon will courteously introduce his intern as a colleague. He will always take the intern with him to see his patients unless there are very special reasons for not doing so. He will strive to set a good example for the intern in his intellectual approach to surgical problems and in his attitude toward patients. It is often a wise thing occasionally to invite the intern to his house to dinner, to meet his family, to see his library. He should at all times try to stimulate the intern to undertake original investigation, a stimulus which is often accomplished by letting the intern see his own interest in clinical or laboratory research. He should never try to curry favor with interns in an effort to possibly have them refer him patients. He will try to give to the intern all the operations which he thinks that the intern is capable of, and will take pains to guide and encourage the first clumsy surgical efforts of the intern. In no event, however, will he subordinate the patient's welfare to the intern's profit. The surgeon will take the time and pains to read all the records which the intern has written and to criticize them if necessary. The surgeon will remember that the intern is human and therefore is susceptible to fatigue. He will be on watch that the intern's living quarters are adequately comfortable, and that the intern is properly fed. He will guide the intern away from contentions with nurses. Follansbee[1] has emphasized several very important duties of the hospital staff to the intern. He says, "The intern should be a daily visitor with the attending physician to all the patients in his department, and the orders of the attendant should be made through him, with such discussion as will explain to him why such orders are made. . . . He should have the opportunity of making careful and complete examinations of all patients whom he visits. . . . He should be taught in detail and by personal example the proper care of accident work. . . ."

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[1] Babcock, W. Wayne: Modern Hospital, 24, 548, June, 1925.

[2] Bachmeyer, A. C.: Modern Hospital, 29, 49, July, 1927.

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[1] Follansbee, George E.: Jour. Amer. Med. Assoc., 88, 773, March 12, 1927.

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